Final Environmental Assessment for

Proposed Habitat Conservation Plan and Incidental Take Permit

Hoopeston Wind Project

Vermilion County, Illinois

August 2017

U.S. Fish and Wildlife Service
Illinois-Iowa Ecological Services Field Office
1511 - 47th Ave
Moline, Illinois 61265

TABLE OF CONTENTS

List of Figures

List of Tables

APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

Applicant	Hoopeston Wind, LLC
BBCS	Bird and Bat Conservation Strategy
BGEPA	Bald and Golden Eagle Protection Act
BO	Biological Opinion
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EA	Environmental Assessment
Eagle Guidance	Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy, Version 2
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESP Board	Illinois Endangered Species Protection Board
FONSI	Finding of No Significant Impact
Fowler Ridge	Fowler Ridge Wind Farm
FR	Federal Register
GHG	greenhouse gas
HCP	Habitat Conservation Plan
HMANA	Hawk Migration Association of North America
Hoopeston Wind	Hoopeston Wind, LLC
IBA	Important Bird Area
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
ILCS	Illinois Compiled Statutes
IL ESPA	Illinois Endangered Species Protection Act
ITP	incidental take permit
kV	kilovolt
m/s	meters per second
MBTA	Migratory Bird Treaty Act
Memorandum	Memorandum for Heads of Federal Departments and Agencies
MET tower	meteorological tower

mph	miles per hour
MW	megawatt
NAAQS	National Ambient Air Quality Standard
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OCRU	Ozark-Central Recovery Unit
PIF	Partners in Flight
Project	Hoopeston Wind Project
REA Model	Resource Equivalency Analysis Model
Recovery Plan	Indiana Bat Draft Recovery Plan: First Revision
rpm	revolutions per minute
Service	U.S. Fish and Wildlife Service
TAL	Technical Assistance Letter
USC	United States Code
WNS	white-nose syndrome

CHAPTER 1. PURPOSE AND NEED

1.1 INTRODUCTION

The U.S. Fish and Wildlife (the Service) received an application for an incidental take permit (ITP), pursuant to the provisions of section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (ESA;16 United States Code [USC] §§ 1531–1544.) for the Hoopeston Wind Project (Project). If issued, the ITP will authorize the incidental take of the Indiana bat (*Myotis sodalis*), a federally endangered species, and northern long-eared bat (*Myotis septentrionalis*), a federally threatened species, during operation of the Project in Vermilion County, Illinois (Figure 1-1). Under section 10 of the ESA, applicants may be authorized, through issuance of an ITP, to conduct activities that may result in take of a listed species as long as the take is incidental to, and not the purpose of, otherwise lawful activities.

The Project is owned and operated by Hoopeston Wind, LLC (Hoopeston Wind or Applicant), a wholly owned subsidiary of IKEA Energy US, LLC. The Project is managed by Apex Wind Asset Management, LLC, a subsidiary of Apex Clean Energy Holdings, LLC. Hoopeston Wind's ITP application includes their Habitat Conservation Plan (Project HCP or proposed HCP) that specifies, among other things, the impacts that are likely to result from taking Indiana bats and northern long-eared bats and the measures Hoopeston Wind will undertake to minimize and mitigate such impacts. The Applicant is applying for an ITP to provide the Project with long-term assurances that no unauthorized take of the Indiana bat or northern long-eared bat will occur that could give rise to liability for Hoopeston Wind or individuals associated with the covered activities described in the proposed HCP. The following Environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 to evaluate the effects of implementing the Applicant's proposed HCP.

It is the Applicant's intent to operate a wind energy facility while complying with the ESA. The Applicant has prepared an HCP to support their application for an ITP for Indiana bats and northern long-eared bats while operating the Project and implementing mitigation activities. In the HCP, the Applicant has expressed a goal to maximize energy production using wind power to create renewable energy objectives and stimulate economic opportunities in the local area, while at the same time minimizing impacts to wildlife. The HCP also states implementing renewable energy will produce fewer emissions of carbon dioxide than traditional sources of energy production and will help in meeting state energy policies and goals, such as Illinois' renewable portfolio standard.

1.1.1 The Hoopeston Wind Project

The Project is an existing wind energy facility located southwest of Hoopeston, Illinois and west of the city of Rossville, Illinois (Figure 1-1). The Project's nameplate capacity is 98-megawatts (MW) and comprises 49 2-MW wind turbine generators, turbine pads, an operations and maintenance building, access roads, collector line system and substation, and a permanent meteorological tower (Figure 1-2). The Project interconnects to an existing Ameren transmission line via approximately 270 feet of overhead 138-kilovolt (kV) transmission line located onsite. The Project has been operating since March 2015.

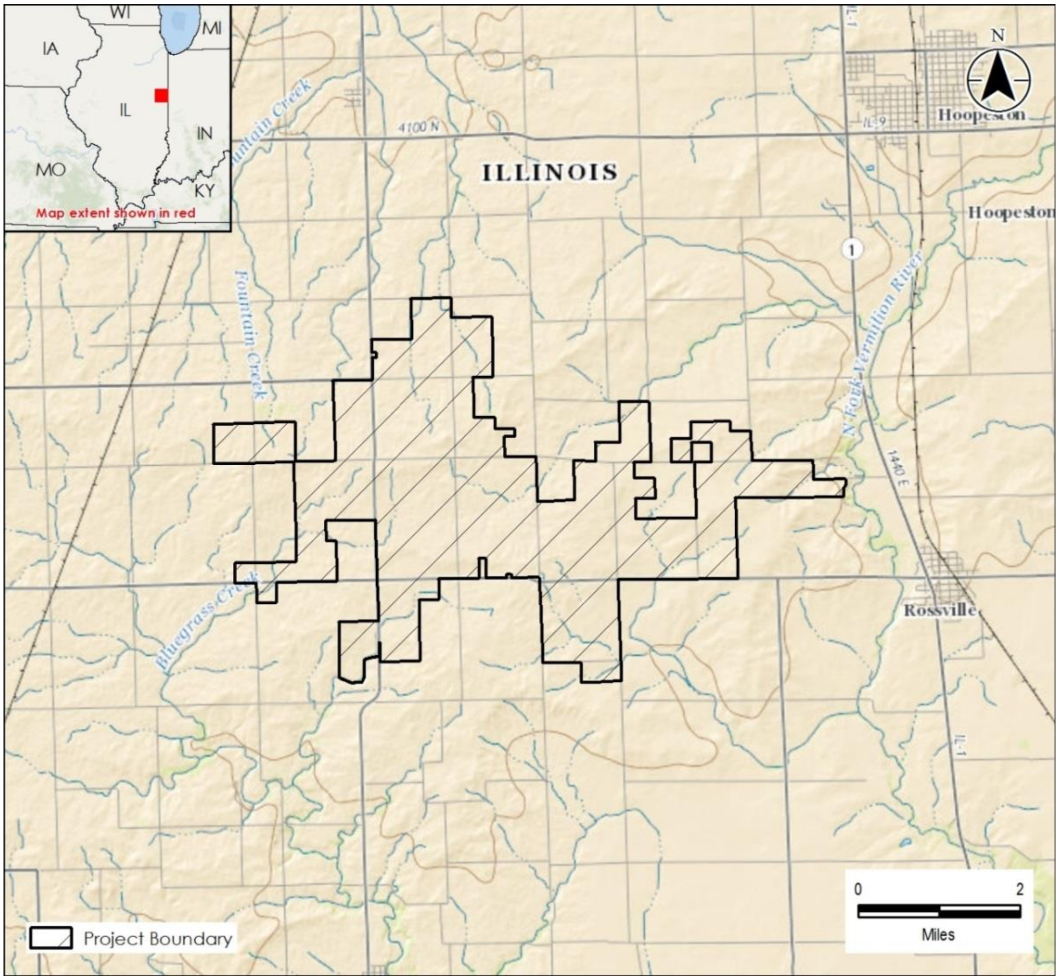

Figure 1-1. **Project area, Hoopeston Wind Project, Vermilion County, Illinois.**

1.1.1.1 Turbines

The Project includes 49 wind turbines (Figure 1-2), model Vesta 100-2.0 MW. Each turbine has three major components: tower, nacelle, and rotor. Turbine towers are approximately 95 meters (312 feet). The nacelle sits atop the tower, and the rotor hub is mounted to the front of the nacelle. Each rotor consists of three composite blades that are approximately 49 meters (161 feet) creating a rotor diameter of 100 meters (328 feet) and rotor-swept area of 7,854 square meters (84,540 square feet). A transformer is located in the nacelle of each turbine that collects the electricity generated. Total turbine height (height when blade tip is in the highest position) is approximately 144 meters (472 feet). As per requirements of the FAA, the Project turbines are equipped with medium-intensity aviation warning lights that are flashing red strobes (L-864) and operate only at night.

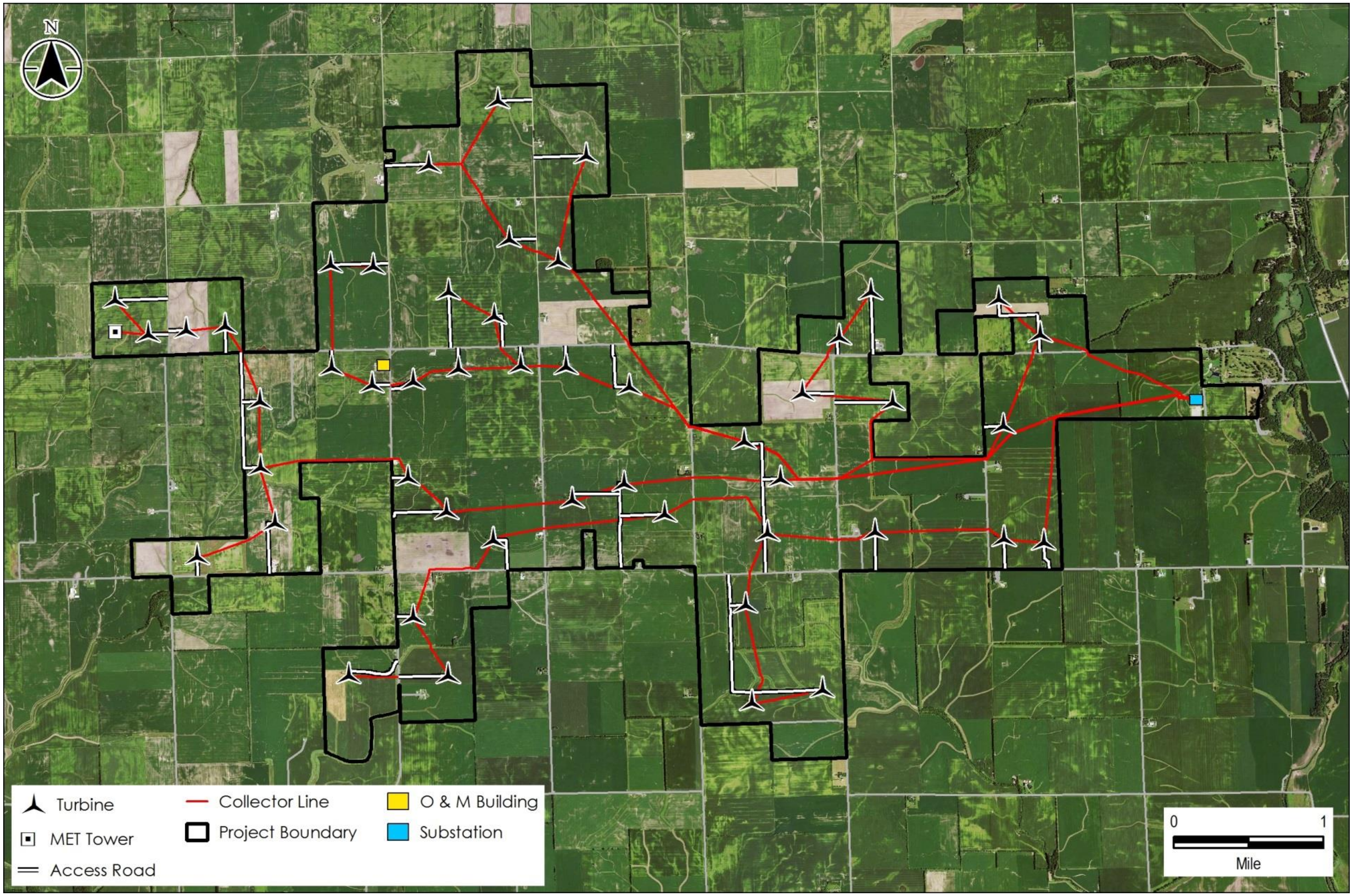

Figure 1-2. Layout of the Hoopeston Wind Project in Vermilion County, Illinois.

The pitch angle of each rotor blade may be independently adjusted, thereby permitting control of rotor speed. Wind speed and direction are measured by anemometers located on each turbine nacelle. Under normal operations, wind speed and direction will inform the adjustment of the blade to go from stalling (flat side of the blade facing wind), causing the rotor to spin and produce energy, to feathering (flat side of blade parallel to wind), causing the rotor to spin at very low revolutions per minute [rpm], if at all.

As designed, the Vesta 100-2.0 MW turbines begin generating energy at wind speeds as low as 3.0 meters per second (m/s; 6.7 miles per hour [mph]) and cut out when wind speeds reach 22 m/s (49 mph). During periods of curtailment, the turbine will regulate its speed, cut in or cut out, according to adjusted operational criteria that have been programmed through the Project's Supervisory Control and Data Acquisition (SCADA) system. The adjusted operations are based on the prescribed curtailment criteria as opposed to the manufacturer ratings.

1.1.1.2 Access Roads and Turbine Pads

New access roads and improvement of existing access roads (Figure 1-2) including existing farm lanes) were constructed to provide access to turbines and substation site. The roads are gravel-surfaced and 16 feet wide, though construction disturbed several areas up to 90 feet wide during the spreading of topsoil. Access to each individual turbine includes a 10-foot wide ring-road around the turbine, also known as the turbine pad.

1.1.1.3 Collection System and Substation

A transformer located in the turbine nacelle raises the voltage of electricity produced by the turbine generator up to the 34.5 kV voltage level of the collection system. The collection system connects to the substation approximately 1.5 miles northwest of Rossville (Figure 1-2). The collector substation steps up voltage from 34.5 kV to 138 kV to allow connection to an existing transmission line.

1.1.1.4 Transmission Line and Switching Station

Approximately 270 feet of overhead 138kV transmission line extends from the substation to the existing interconnection substation and transmission line owned by an Illinois utility subsidiary of Ameren Illinois Corporation.

1.1.1.5 Meteorological Towers

The Project has one meteorological tower (MET tower) that collects wind data and supports performance testing of the Project. The MET tower is 95-m (312 feet) tall and an unguyed, self-supporting lattice steel structure. The MET tower is located in an agricultural field near the western edge of the lease boundary of the Project (Figure 1-2).

1.1.1.6 Operations and Maintenance Building

An operations and maintenance building is located approximately 6.5 miles west of Rossville on N 750 East Road. This site houses operations personnel, equipment, and materials, and provides staff parking.

1.1.2 Habitat Conservation Plan Project Area

The covered lands for this HCP are defined as the Project area, which is shown in Figure 1-1 and Figure 1-2. The Project area is approximately 8,884 acres and includes the outermost boundary of the participating landowner property. The requested ITP will cover the entire Project area. The Project area includes all areas that will be affected directly and indirectly by activities associated with Project operations, maintenance, and decommissioning. The covered lands will also include all areas that will be affected directly and indirectly by activities associated with Project mitigation, the sites for the winter and summer habitat mitigation projects, which have not yet been identified.

1.2 REGULATORY AND POLICY BACKGROUND

1.2.1 National Environmental Policy Act

The environmental review process under NEPA provides the acting agency with the framework for reviewing the federal action, alternatives, environmental effects, and possible mitigation of potentially harmful effects of the action. NEPA is an environmental law fashioned to ensure careful decision-making with respect to the environment. NEPA also established the Council on Environmental Quality (CEQ) in the Executive Office of the President to formulate and recommend national policies to ensure that the programs of the Federal government exercise careful decision-making with respect to the environment. The CEQ has set forth regulations (40 Code of Federal Regulations [CFR] §§1500-1508) to assist federal agencies in implementing NEPA and to ensure that the environmental impacts of any proposed decisions are fully considered, and that appropriate steps are taken to mitigate potential environmental impacts. The NEPA review also provides an opportunity for the public to be involved in the acting agency's decision-making process. For this Project, the public had the opportunity to comment on the drafts EA and Project HCP. The culmination of the EA process is either a Finding of No Significant Impact (FONSI) or a decision to prepare an Environmental Impact Statement (EIS). This EA and its analyses assist the Service with making an informed decision on issuance of an ITP. This EA is the mechanism of the Service's procedure for recording the results of a comprehensive planning and decision-making process surrounding Hoopeston Wind's application for an ITP.

The purpose of an EA is to determine the significance of environmental impacts associated with a proposed federal action and to look at alternative means to achieve the agency's objectives. EAs are intended to be concise documents that:

1) briefly analyze the impacts of a proposed action to determine the significance of the impacts and to determine whether an EIS is needed,
2) aid an agency's compliance with NEPA when no EIS is necessary, and
3) facilitate preparation of an EIS when one is necessary (40 CFR §1508.9).

An EA should include brief discussions of:

1) the need for the proposal,
2) alternative courses of action for any proposal which involves unresolved conflicts concerning alternative uses of available resources,
3) the environmental impacts of the proposed action and alternatives, and
4) a listing of agencies and persons consulted (40 CFR §1508.9(b)).

When determining whether an EIS should be prepared, the CEQ lists two distinct factors that should be considered when determining whether the environmental impacts will be significant: context and intensity. "Context" means that the significance of an action must be analyzed in several settings, such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the impacts in the locale rather than in the world as a whole. Both short- and long-term effects are relevant (40 CFR §1508.27(a)). "Intensity" refers to the severity of impact, and a number of sub-factors are generally considered in evaluating intensity. These include:

(a) Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial;
(b) The degree to which the proposed action affects public health or safety;
(c) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas;
(d) The degree to which the effects on the quality of the human environment are likely to be highly controversial;
(e) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks;
(f) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
(g) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts;
(h) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources;
(i) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973; and
(j) Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment. (40 CFR §1508.27(b)).

In addition to considering the above factors when determining whether an EIS is necessary, an agency should also determine under its own procedures whether the proposal requires an EIS. Additional criteria that the Service follows in determining whether to prepare an EIS include:

(a) controversy over environmental effects (e.g., major scientific or technical disputes or inconsistencies over one or more environmental effects);
(b) change in Service policy having a major positive or negative environmental effect;
(c) precedent-setting actions with wide-reaching or long-term implications (e.g., special use permits for off-road vehicles, mineral extraction, new road construction);
(d) major alterations of natural environmental quality, that may exceed either local, state or Federal environmental standards;
(e) exposing existing or future generations to increased safety or health hazards;
(f) conflicts with substantially proposed or adopted local, regional, state, interstate or Federal land use plans or policies, that may result in adverse environmental effects;
(g) adverse effects on designated or proposed natural or recreation areas, such as wilderness areas, parks, research natural areas, wild and scenic rivers, estuarine, sanctuaries, national recreation areas, habitat conservation project areas, threatened and endangered species, fish hatcheries, wildlife refuges, lands acquired or managed with Dingell-Johnson/Pittman-Robertson funds, unique or major wetland areas, and lands within a 100-year floodplain; and

(h) removal from production of prime and unique agricultural lands, as designated by local, regional, State or Federal authorities; in accordance with the Department's Environmental Statement Memorandum No. ESM 94-7 (USFWS Manual, 550 FW 3 (USFWS 1996)).

Ultimately, the decision whether to prepare an EIS is a matter of professional judgment requiring consideration of the issues in question and the matters documented in the EA. The determination must be reasonable in light of the circumstances involved in the particular project being evaluated, and in light of any past, present, or foreseeable future actions.

On January 14, 2011, the CEQ issued a Memorandum for Heads of Federal Departments and Agencies (Memorandum). The Memorandum stresses the importance of mitigation under NEPA, and explicitly approves of the use of a "mitigated FONSI" when the NEPA process results in enforceable mitigation measures (Memorandum p. 7, n.18). The Memorandum builds on previous guidance from CEQ that states when an agency develops and makes a commitment to implement mitigation measures to avoid, minimize, rectify, reduce, or compensate for significant environmental impacts (40 CFR §1508.20), then NEPA compliance can be accomplished with an EA coupled with a FONSI. Using mitigation to reduce potentially significant impacts to support a FONSI enables an agency to conclude the NEPA process, satisfy NEPA requirements, and proceed to implementation without preparing an EIS. In such cases, the basis for not preparing the EIS is the commitment to perform those mitigation measures identified as necessary to reduce the environmental impacts of the proposed action to a point or level where they are determined to no longer be significant. That commitment should be presented in the FONSI and any other decision document. CEQ recognizes the appropriateness, value, and efficacy of providing for mitigation to reduce the significance of environmental impacts; consequently, when that mitigation is available and the commitment to perform it is made, there is an adequate basis for a mitigated FONSI.

Based on review of the above referenced factors and CEQ guidance, the Service has concluded that an EA is the appropriate instrument for reviewing the Applicant's proposal. The Service made this determination based on the following:

1) the Project is not located near suitable winter or summer bat habitat;
2) the Project will not impact critical habitat;
3) the Applicant will implement a robust multi-year monitoring and adaptive management program;
4) the Applicant will share all data and information with the Service and make the information public;
5) the Project site is low risk for resident and migratory birds because of its size, distance from sensitive avian resource areas, lack of open water, and predominantly agriculture setting;
6) the Applicant's proposed mitigation measures will offset the impact of taking covered species;
7) potential impacts to non-covered species (i.e., birds and non-listed bats) will be minor;
8) the Project will facilitate a positive impact on the quality of the human environment by reducing the emission of greenhouse gases for the provision of domestic energy;
9) the Project will not affect historic or cultural resources, park lands, wetlands, wild and scenic rivers, or ecologically critical areas;
10) the action will not contribute to cumulatively significant impacts, as local effects will be either avoided and/or minimized and fully mitigated;
11) the action does not adversely affect any object listed or eligible for listing in the National Register of Historic Places or cause loss or destruction of any significant, cultural, or historical resources;
12) the action will not result in any violation of federal, state, or local law or requirements imposed for the protection of the environment;

13) the issuance of an incidental take permit is consistent with Service policy to promote the use of renewable energy while assiduously implementing its responsibilities under the ESA, Migratory Bird Treaty Act, and NEPA; and
14) the action does not expose future generations to increased safety or health hazard, does not conflict with local, regional, state or federal land use plans or policies, and does not impose adverse effects on designated or proposed natural or recreation areas.

1.2.2 Endangered Species Act

The Service is responsible for implementing and enforcing federal wildlife laws, including the ESA. Federally listed threatened and endangered species and designated critical habitat are governed by the ESA and its implementing regulations (50 CFR parts 13 and 17). The Service is authorized to identify species in danger of extinction and provide for their management and protection. The Service also maintains a list of species that are candidates for listing pursuant to the ESA.

Section 9 of the ESA prohibits certain activities that directly or indirectly affect endangered species. For the purposes of the EA and the proposed ITP, the most relevant activity is the prohibition of take of wildlife species listed under the ESA. The ESA defines the term take to include harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these acts (16 USC §1532(19)). Take of listed wildlife is illegal unless otherwise authorized by the Service (or National Marine Fisheries Service [NMFS] in marine systems) pursuant to section 10 of the ESA.

1.2.2.1 Endangered Species Act Section 10(a)(1)(B)

The ESA was amended in 1982 to allow the Service and NMFS to authorize the taking of listed species incidentally to an otherwise lawful activity by non-Federal entities, such as states, counties, local governments, and private landowners. To receive a permit, the applicant submits a conservation plan (also referred to as an HCP) that meets the criteria included in the ESA and its implementing regulations (50 CFR parts 17 and 222), as follows:

1) The taking will be incidental to otherwise lawful activities;
2) The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such takings;
3) The applicant will ensure that adequate funding for the HCP will be provided;
4) The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild;
5) The applicant has met the measures, if any, required by the Service as being necessary or appropriate, for the purposes of the plan; and
6) The Service has received such other assurances as may be required that the plan will be implemented.

HCP Handbook

The Service and NMFS later developed a comprehensive guidance on the incidental take permit program, HCP Handbook (USFWS and NMFS 1996). The HCP Handbook incorporates more than a decade of improvements and innovations in updated policies and procedures in the HCP program, and provides ways to reduce the regulatory burden on private landowners while addressing the habitat needs of listed species. In December 2016, the Service and NMFS made available a revised HCP Handbook (USFWS and NMFS 2016) that provides proposed updated guidance on HCP planning and implementation.

"No Surprises" Policy and Regulation

In 1998, the Service and NMFS decided the HCP program needed a clearer policy associated with the permit regulations in 50 CFR §§17.22, 17.32, and 222.307 regarding the assurances provided to landowners. This prompted the ''No Surprises'' policy, which evolved after more than 10 years of working with private landowners during the development and implementation of HCPs. The Service and NMFS later codified the ''No Surprises'' policy into a final rule, 50 CFR §§17.22(b)(5), 17.32(b)(5) and 222.307(g), on February 23, 1998 (USFWS and NMFS 1998; 63 Federal Register [FR] 8859-8873). The "No Surprises" policy ensures that non-federal property owners are provided economic and regulatory certainty regarding the overall cost of species conservation and mitigation, provided that the affected species are adequately covered, and the permittee is properly implementing the HCP and complying with the terms and conditions of the HCP, permit, and Implementing Agreement IA if used.

Treatment of Unlisted Species

When amending the ESA in 1982, Congress clearly intended for the section 10 process to provide for the conservation of listed and unlisted species and protect section 10 permittees from the uncertainties of future species listings. Although the take provisions of section 10 only apply to listed species, HCPs may address both listed and unlisted species. If an unlisted species is adequately addressed in the HCP and the species is listed subsequent to the permit issuance, the permittee would not be required to provide additional conservation measures or mitigation requirements beyond what is described in the HCP (USFWS and NMFS 1998).

Five-Point Policy

In June 2000, the Service and NMFS published a final addendum to the HCP Handbook, the Five-Point Policy (USFWS and NMFS 2000; 65 FR 35242-35257). This policy provides clarifying guidance to the Service and NMFS in conducting the HCP program and to permit Applicants. The final addendum supplements the HCP Handbook and "No Surprises" final rule, and is to be applied within the context of the existing ESA statute and regulations. In addition to the permit issuance criteria (listed above), an HCP should address the following five points:

1. Biological Goals and Objectives
    a. Goals: A statement of the expected biological outcome for the covered species and habitats.
        i. What does the Plan hope to achieve?
    b. Objectives: the specific, measurable actions to be implemented to achieve the goals
        i. What will the Applicant do to achieve the goals?
2. Adaptive Management
    a. A method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.
3. Monitoring
    a. Assess compliance and project impacts, and verify progress toward the biological goals and objectives
    b. Provide the scientific data necessary to evaluate the success of the HCP's operating conservation programs with respect to possible use of those strategies in future HCPs or other programs for those covered species
4. Permit Duration
    a. Duration of the applicant's proposed activities
    b. Duration of expected positive and negative effects on covered species
5. Public Participation

a. Public comment
    i. 30 days for low-effect HCP, individual permits under a Programmatic HCP, and major amendments to existing HCPs
    ii. 60 days (minimum)
    iii. 90 days for large-scale or regional projects

1.2.2.2 Endangered Species Act Section 7

Under section 7 of the ESA, issuance of an ITP is a federal action subject to section 7 compliance. This means the Service must conduct an internal formal section 7 consultation on permit issuance. For the purposes of the Project ITP, the section 7 consultation will be between the Assistant Regional Director for Ecological Services and the Field Office that assisted the Applicant in developing the HCP.

The Service's internal consultation on the section 10 action ensures that ITP issuance meets ESA standards under section 7. Section 10 issuance criteria includes the regulatory definition of jeopardy under section 7, and the section 7 consultation represents the last internal "check" that the fundamental standard of avoiding jeopardy has been satisfied. Formal consultation terminates with preparation of a biological opinion (BO), which provides the Services' determination as to whether the proposed action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

The section 7 consultation is also when the Service may develop reasonable and prudent measures and terms and conditions to minimize anticipated incidental take, or, if necessary, reasonable and prudent alternatives to eliminate the risk of jeopardy. Reasonable and prudent measures are required actions the Regional Director believes necessary or appropriate to minimize the impacts of incidental take. Reasonable and prudent measures, terms, and condition are included in the BO.

The BO for a section 10(a)(1)(B) permit application must contain, at a minimum:

1) A summary of the information on which the opinion is based.
2) A detailed discussion of the effects of the HCP and ITP on listed species or critical habitat.
3) The Service's opinion on whether the action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. This constitutes the Service's "jeopardy" or "no jeopardy" determination with respect to the permit application.

1.2.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA; 16 USC 703-712) affords protection to all birds that occur in the U.S. with the exception of gallinaceous birds (i.e., game birds) and introduced species. Species protected under the MBTA are listed under 50 CFR 10.13. The MBTA prohibits the taking and disturbance (both intentional and unintentional) of migratory birds, their nests, or young without prior authorization from the Service.

Because the Project has the potential to take or disturb birds protected under the MBTA, this EA addresses impacts to migratory birds.

1.2.4 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA; 50 CFR 22.26) prohibits the 'take' of a bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*). The Service published the Eagle Permit Rule on September 11, 2009 under BGEPA, authorizing limited issuance of take permits for bald eagles and golden eagles for cases where the take is compatible with the preservation of the eagle species and cannot practicably be avoided (FR 46836-46879). On May 5, 2013, the Service made available their Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy, Version 2 (Eagle Guidance; USFWS 2013*c*). The Eagle Guidance interprets and clarifies the Eagle Permit requirements in the regulations (50 CFR 22.26 and 22.27). The Eagle Guidance also informs pre-construction survey requirements, avoidance and minimization measures, and monitoring requirements at commercial wind projects.

The Project has a low likelihood for taking or disturbing eagles. However, wind projects have killed bald eagles, including projects in the Midwest. Therefore, this EA addresses potential effects to eagles.

1.2.5 Illinois Endangered Species Protection Act

The Illinois Endangered Species Protection Act (IL ESPA;520 Illinois Compiled Statutes [ILCS] 10/1) was established in 1972. The IL ESPA is administered by the Illinois Endangered Species Protection Board (ESP Board). The ESP Board lists species and advises the Illinois Department of Natural Resources (IDNR) on their recovery and protection. Any species or subspecies of animal or plant designated as endangered or threatened by the Service is automatically listed as an endangered or threatened species under the IL ESPA and thereby placed on the Illinois list by the ESP Board without notice or public hearing. The ESP Board may list other species in addition to those federally listed (520 ILCS 10/7).

In 2000, the IL ESPA was amended by the addition of provisions allowing the IDNR to authorize incidental taking of Illinois listed endangered and threatened species under prescribed terms and conditions (520 ILCS 10/5.5). The amendment stipulates that the taking must be incidental to, and not the purpose of, the carrying out of an otherwise lawful activity and requires that applicants submit a conservation plan to the IDNR. Because, the Project has the potential to affect species protected under IL ESPA, this EA addresses effects to state-listed species.

1.3 ACTION AGENCY PURPOSE AND NEED

1.3.1 Purpose of the Environmental Assessment

This EA prepared by Service evaluates and publicly discloses the potential environmental impacts that could result from issuance of an ITP to Hoopeston Wind for the Indiana bat and northern long-eared bat. It was prepared in accordance with the NEPA of 1969, CEQ's regulations for implementing NEPA at 40 CFR 1500-1508, and the Service's policies and procedures for compliance with those laws and regulations (see Department of Interior Manual and regulations for implementing NEPA at 43 CFR 46).

1.3.2 Proposed Action

The proposed federal action being evaluated by this EA is the Service's issuance of an ITP for the purpose of authorizing take of Indiana bats and northern long-eared bats within the framework of an HCP that meets the statutory and regulatory criteria in Section 10(a)(2)(B) of the ESA and 50 CFR 17.22 (b)(l) and 17.32(b)(l).

1.3.3 Purpose and Need Action

The Service's purpose in considering the proposed action is to fulfill our authority under the ESA section 10(a)(1)(B). When Congress passed the ESA in 1973, it declared, "[A]ll Federal departments and agencies shall seek to conserve [listed] species and shall utilize their authorities in furtherance of the purposes of [the ESA]." (ESA section 2(c)(1)). While all federal agencies are directed to utilize their authorities in furtherance of the ESA, the Service and NMFS have unique responsibilities for administering and carrying-out the purposes of the ESA. Those purposes are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in the ESA (ESA, section 2(b)). In carrying out these responsibilities, the Service must ensure that our decisions involving ITPs and HCPs support long-term species and ecosystem conservation objectives; are based on sound scientific principles; and are in compliance with environmental laws and regulations, Executive Orders (EO), and agency directives and policies.

Section 10 of the ESA specifically directs the Service to issue ITPs to non-Federal entities for take of endangered and threatened species when the criteria in section 10(a)(2)(B) are satisfied by the applicant. Once we receive an application for an incidental take permit, the Service reviews the application to determine if it meets application criteria on Section 10(a)(1)(B).

On July 21, 2016, the Service received an application from Hoopeston Wind for an incidental take permit under the authority of Section 10(a)(1)(B) of the ESA. If the application is approved and the Service issues a permit, the permit would authorize Hoopeston Wind to take Indiana bats and northern long-eared bats as a result of their covered activities.

The underlying issue to which the Service is responding is a need for Hoopeston Wind to comply with the ESA by either avoiding take of an ESA-listed species (in which case an ITP is not needed) or to acquire a permit that authorizes take of listed species under the ESA. Hoopeston Wind has chosen to apply for an ITP, and the Service must respond to the permit application. Take of the Indiana bat and northern long-eared bat is reasonably anticipated during Project operations under the action alternatives. Consistent with the requirements of the ESA, the Applicant commits to a range of conservation measures that will, to the maximum extent practicable, minimize and mitigate the impacts of taking Indiana bats and northern long-eared bats. Thus, the HCP, if approved, is designed to avoid and minimize take of the species in the course of carrying out the proposed covered activities, as well as to mitigate the impact of such take to the maximum extent practicable.

1.3.4 Decisions to be Made

This EA process will culminate with a decision made by the Service's Midwest Region Regional Director on one of the three alternatives found in Chapter 2 of this EA. Once an alternative is selected, the Regional Director will decide whether the alternative selected will significantly impact the quality of the human environment, as defined by the NEPA and its implementing regulations. If he finds that the alternative selected will not result in significant environmental impacts, he will issue a "Finding No Significant Impact." If he finds that the alternative selected will result in significant environmental impacts, he will issue a Notice of Intent to prepare an Environmental Impact Statement (EIS).

CHAPTER 2. ALTERNATIVES

Pursuant to NEPA, federal agencies must consider a range of reasonable alternatives to the proposed action when evaluating the environmental effects of their actions (40 CFR 1505.1(e)). This chapter describes the Applicant's proposed action and alternatives.

2.1 DEVELOPMENT OF ALTERNATIVES

The scope of reasonable alternatives is defined by the purpose and need for the action and guided by the goals and objectives of the acting agency. Reasonable alternatives include those that are practical or feasible from both a technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the Applicant. Alternatives were developed to address the potential for take of Indiana bats and northern long-eared bats during Project operation and are primarily operational alternatives relating to the dates and times of operation and changes in cut-in speed (i.e., the wind speed at which turbines begin generating power and sending it to the grid). The alternatives do not address other aspects of the wind farm, such as turbine siting and construction, because the Project is already constructed and operating, and no suitable Indiana bat or northern long-eared bat summer habitat is found within the Project area. The potential effects on the human environment for each of the alternatives are described in detail in Chapter 4 Environmental Consequences.

2.2 ALTERNATIVES RETAINED FOR DETAILED ANALYSIS

In this EA, we retained three alternatives for detailed analyses, which are described below:

Alternative 1: No-Action Alternative (No ITP Issued and No HCP Required)

Alternative 2: 5.0 m/s & 3.0 m/s Cut-in Speeds and Feathering (Mixed Operations: ITP Issuance, HCP with Minimization and Mitigation Measures)

Alternative 3: 3.0 m/s Cut-in Speed with Feathering (Applicant's Proposal: ITP Issuance, HCP with Minimization and Mitigation Measures)

2.2.1 Alternative 1: No-Action Alternative

Under this alternative, the Service would not issue a permit to Hoopeston Wind and their HCP would not be implemented because take of Indiana bats and northern long-eared bats would be unlikely at the Project. Therefore, Hoopeston Wind would not need an ITP or to implement an HCP.

2.2.1.1 Operational Minimization Measures

The Project began operating in March 2015 under the terms of a Technical Assistance Letter (TAL; issued on March 4, 2014; Appendix G) from the Service. Hoopeston Wind implemented the terms of the March 2014 TAL in fall 2015 and spring and summer 2016. Hoopeston Wind implemented operational adjustments by feathering turbines and raising the cut-in speed[1] from the manufacturer's rated cut-in speed of 3.0 m/s (7.8 mph) to 6.9 m/s (15.7 mph) from sunset to sunrise during the fall migration period, August 1–October 15.

During August 1-October 15, 2016, Hoopeston Wind operated the Project by feathering turbines at 5.0 m/s (11.2 mph) cut-in speed. The Project is currently operating under this curtailment regime under a new TAL the Service issued on July 27, 2017 (Appendix G). However, under the No-Action Alternative, Hoopeston Wind would operate the Project under the restrictions specified in the original March 2014 TAL (feathering at 6.9 m/s in fall). Take of Indiana bats and northern long-eared bats would be unlikely at the Project under this operational regime. Hoopeston Wind would implement the current Bird and Bat Conservation Strategy (BBCS) to avoid, minimize, mitigate, and monitor potential impacts to birds and bats (Appendix A).

2.2.1.2 Mitigation

Because take of Indiana bats and northern long-eared bats would be unlikely at the Project under this operational regime, Hoopeston Wind would not need to mitigate for take of listed bats.

2.2.1.3 Fatality Monitoring

To verify anticipated avoidance of take, Hoopeston Wind would conduct post-construction monitoring as specified in the TAL (Appendix G) and described in their BBCS (Appendix A). Searches would be conducted during the spring (1 April to 15 May) and fall (1 August to 15 October) once per week. Trained observers would search all turbines on roads and pads (within 40 meters (131 feet) of the turbine center) during the first 3 years of operation, including the years prior to the Service's decision on this EA. In addition to road and pad searches, trained observers would search cleared 40-meter (131 feet) radius plots at 10% of the turbines for the first 3 years.

After the first 3 years, trained operations personnel may conduct a follow-up carcass searches during the fall season to confirm that there has been no significant increase in overall bird or bat mortality.

2.2.1.4 No-Action Alternative Summary

The No-Action Alternative meets the Service's goals and objectives for protecting and conserving the Indiana bat and northern long-eared bat and their habitats in the context of the Project for the continuing benefit of the people of the United States. Under the No-Action Alternative, Project operations are unlikely to pose risks to Indiana bats or northern long-eared bats because the turbines would be feathered until wind speeds reach 6.9 m/s during the fall (August 1 through October 15). The No-Action Alternative is expected to be the alternative implemented if the Service denies the Applicant the ITP. The Applicant would not be required to provide mitigation under this alternative.

---

[1] **Feathered** blades are pitched, i.e., rotated, so that the blade edge points directly into the wind, reducing blade rotation speeds to less than 2 rpm to minimize risks to bats and birds. Not all turbine designs provide the feathering capability. Turbines that do not feather whenever wind speeds are below cut-in speed will spin freely at more than 2 rpm and increase collision risk. Hoopeston Wind selected a turbine model that includes feathering capability when winds are below the cut-in speed.

Cut-in speed is the minimum wind speed at which a wind turbine starts to generate usable power. This is around 3-4 m/s for turbines similar to those operating at the Project. Increasing wind speed can eventually begin to pose risks to the turbine. Conversely, the cut-out speed, usually about 25 m/s, is the wind speed at which the braking system is applied to prevent damage to the turbine.

2.2.2 Alternative 2: Mixed Operations (5.0 m/s & 3.0 m/s Cut-in Speeds with Feathering: ITP Issuance, HCP with Minimization and Mitigation Measures)

Under Alternative 2, the Service would issue an ITP to authorize incidental take of Indiana bats and northern long-eared bats associated with the Project operation. Hoopeston Wind would implement an HCP that includes:

1) Operational measures to reduce take of listed bats;
2) Off-site conservation measures to mitigate the impact of incidentally taking Indiana bats and northern long-eared bats through protection, enhancement, and management of suitable habitat;
3) Post-construction monitoring and adaptive management plan to measure effectiveness of minimization measures and validate incidental take estimates; and
4) Monitoring and adaptive management plan to deal with uncertainties related to minimizing take and mitigating potential impacts of take.

Hoopeston Wind would also implement the BBCS to reduce the potential for impacts to migratory birds. However, the monitoring proposed in the BBCS would be replaced by the monitoring plan described for covered species (summarized in Section 2.2.2.3 and Section 2.2.3.3). Elements in the BBCS that address Indiana bats, northern long-eared bats, and all other bats would be replaced by the conservation measures described in the HCP.

2.2.2.1 Operational Minimization Measures

Under Alternative 2, Hoopeston Wind would implement the following minimization measures:

1) Feather and curtail turbine operations at wind speeds below 5.0 m/s (29 turbines) and 3.0 m/s (20 turbines) from sunset to sunrise when the ambient temperature is above 10°C from August 1 through October 15; and
2) Feather all turbines until wind speeds reach manufacturer's rated cut-in speed 3.0 m/s) October 16 through July 31.

The feathering/cut-in process would be computer-controlled, under a 10-minute rolling wind speed and temperature average, and turbines would feather or cut-in throughout the night as wind speed and temperatures fluctuate below and above the assigned cut-in speed thresholds.

The rationale for the 5.0 m/s cut-in speed in fall with nighttime temperatures above 10°C is based on curtailment[2] studies (Baerwald et al. 2009, Arnett et al. 2010, Good et al. 2011) and bat activity studies (O'Farrell and Bradley 1970, Vaughan et al. 1997, Fiedler 2004, Reynolds 2006, USFWS 2007). These studies found that turbines feathered at 5.0 m/s can reduce bat fatalities by at least 50%, and average reductions have been closer to 67%. The rationale for feathering only is based on studies that tested feathering below the manufacturer's cut-in speed (Baerwald et al. 2009, Young et al. 2011, Good et al. 2012), which found this adjustment to reduce overall bat mortality by a minimum of 35%.

---

[2] Technically, curtailment is the act of limiting the supply of electricity to the grid during conditions when it would normally be supplied; i.e., a turbine or an entire project is not operating (shut down). In the case of the curtailment studies, operators adjusted (raised) the turbine cut-in speeds to curtail operations and researchers observed bat fatality results.

The operational adjustment regime under Alternative 2 includes a curtailment treatment and a feathering only treatment. Employing the mixed operations strategy would allow Hoopeston Wind to measure the effectiveness of raising cut-in speeds for reducing bat mortality specific to the Project site. The two treatments can be compared directly as opposed to using mortality data from other similar types of wind farms that employed no operational adjustments.

In Section 6.4.2 of the Project HCP, the Applicant estimated Indiana bat and northern long-eared bat take using averages derived from three take estimation methods that relied on regional, national, and site-specific data. We used the average of 2.8 Indiana bats per year and 3.3 northern long-eared bats in the absence of the proposed minimization measures as our baseline to estimate take for Alternative 2. Under Alternative 2, Hoopeston Wind would achieve at least 50% reduction in all bat mortality at 29 turbines and at least 35% reduction at 20 turbines. Assuming listed bats would experience these same reductions in mortality, this translates to taking 1.57 Indiana bats and 1.85 northern long-eared bats per year. Over the 30-year permit term, the Project could incidentally take 47.1 Indiana bats and 55.5 northern long-eared bats.

2.2.2.2 Mitigation

Under Alternative 2, Hoopeston Wind would implement mitigation measures to compensate for the impact of taking 47.1 Indiana bats and 55.5 northern long-eared bats. Of the 47.1 Indiana bats taken, 75% or 35.3 would be females, and of the 55.5 northern long-eared bats taken, 50% or 27.8 would be females.

Using the Service's resource equivalency analysis (REA; USFWS 2013*b*) for Indiana bats, the lost reproductive potential of these females would be 67.3 female Indiana bat pups and 52.7 female northern long-eared bat pups. Therefore, Hoopeston Wind would need to mitigate for taking 102.6 female Indiana bats and 80.5 female northern long-eared bats (see Section 4.3.3.6). Like Alternative 3, Alternative 2 would likely include measures for summer habitat mitigation, as opportunities for winter habitat mitigation are uncommon. Using the REA Model to calculate mitigation credit due to offset the impact of the taking, the Applicant would need to provide 117 acres of summer habitat restoration or protection.

Mitigation measures for the impact of the taking would follow the Service guidelines (USFWS 2013*b*). Under Alternative 2, Hoopeston Wind would implement mitigation measures similar to those described in the Applicant's proposal, which is summarized in Section 2.2.3.2 and described in detail in Section 7.2.2 in the Project HCP.

2.2.2.3 Fatality Monitoring

Fatality monitoring under this alternative would follow the same protocol as described for Alternative 3 (see Section 2.2.3.3 below and section 7.3 of the HCP). Following each season of monitoring, Hoopeston Wind would derive a take estimate (bats per turbine) for turbine treatments, in this case turbines operating at 3.0 m/s and 5.0 m/s cut-in speeds. Using a species composition approach, Hoopeston Wind would derive confidence intervals for both take estimates, and then determine whether their observed take was within their authorized take for each species.

2.2.2.4 Adaptive Management

Under Alternative 2, the Applicant would use adaptive management to adjust minimization measures as necessary to avoid exceeding authorized take limits. The Applicant would measure effectiveness of turbine operations in reducing bat mortality and adjust operations for both turbine adjustment treatments accordingly to stay within the level of take authorized by the ITP. All changes in operational protocols triggered by adaptive management would be conducted in conference with the Service.

We did not formally develop an adaptive management strategy for Alternative 2, as this effort should be developed in collaboration with the Applicant. However, we provide the following as a possible adaptive management strategy for Alternative 2.

1. After Year 3, average fall Indiana bat mortality >1.57 bats per year OR average fall northern long-eared bat mortality >1.85
    a. Increase cut-in speed at 3.0 m/s turbines to 4.0 m/s.
    b. Implement intense monitoring for 2 years in fall.
    c. Review and update, as necessary, monitoring protocols to assess the effectiveness of the curtailment and blade feathering strategies.
2. After Year 3, average fall Indiana bat mortality <1 bat per year AND average fall northern long-eared bat mortality <1 bats per year.
    a. Decrease cut-in speed at 5.0 m/s turbines to 4.0 m/s.
    b. Implement intense monitoring for 2 years in fall.
    c. Review and update, as necessary, monitoring protocols to assess the effectiveness of the curtailment and blade feathering strategies.
3. In any monitoring year after Year 3, based on cumulative observations at all turbines predicted future take for remaining term of the permit is likely to exceed the authorized amount
    a. Evaluate with the Service adjusting operational protocols to increase cut-in speeds during the fall migration period in a manner necessary to stay within authorized levels of potential take.
    b. Evaluate with Service the installation of proven, cost-effective bat deterrent devices at the turbine or group of turbines implicated in the find, should that technology become commercially available.
    c. Implement additional monitoring as appropriate to assess effectiveness of implemented measures and ensure compliance with the ITP.
4. 1 northern long-eared bat carcass or 1 Indiana bat carcass found in spring or summer
    a. Review and update, as necessary, monitoring protocols to assess the effectiveness of the blade feathering strategy.
    b. Raise cut-in speed to 5.0 m/s at all turbines from April 1 through July 31.
    c. Implement intense monitoring from April 1 through July 31 for 2 years.

When adopting more restrictive operational protocols, reductions in cut-in speed may be justified if the increased cut-in speed results in a greater-than-expected reduction in fatalities. These decisions would be made collaboratively between the Service and Hoopeston Wind.

2.2.2.5 Option Under Alternative 2: 5.0 m/s Cut-in Speed at all Turbines

Alternative 2 includes an option for Hoopeston Wind to implement an HCP with operational measures to reduce take of listed bats by employing a 5.0 m/s cut-in speed at all 49 turbines, from sunset to sunrise when the ambient temperature is above 10°C from August 1 through October 15. Under this 5.0 m/s option, Alternative 2 would be executed as described with only this modification to operational adjustments.

In Section 6.4.2 of the Project HCP, the Applicant estimated Indiana bat and northern long-eared bat take using averages derived from three take estimation methods that relied on regional, national, and site-specific data. We used the average of 2.8 Indiana bats per year and 3.3 northern long-eared bats in the absence of the proposed minimization measures as our baseline to estimate take for this option. Employing this option, Hoopeston Wind would achieve at least 50% reduction in all bat mortality at 49 turbines. Assuming listed bats would experience these same reductions in mortality, this translates to taking 1.40 Indiana bats and 1.65 northern long-eared bats per year. Over the 30-year permit term, the Project could incidentally take 42.0 Indiana bats and 49.5 northern long-eared bats.

Under this option, mitigation, fatality monitoring, and adaptive management would be applied as described for Alternative 2.

2.2.2.6 Alternative 2 Summary

Within the context of this Project, Alternative 2 meets the Service's purpose to ensure ESA compliance for the Project to avoid, minimize, and mitigate take of listed species and legally authorize the incidental take of the Indiana bat and northern long-eared bat consistent with permit issuance criteria (section 10(a)(1)(B) of the ESA) and associated implementing regulations [50 CFR 17.22(b)(2) and 17.32(b)(2)]. The Service's goal within the context of the permit application is to conserve the Indiana bat and northern long-eared bat and their habitats in the Plan area and region for the continuing benefit of the people of the United States. Under Alternative 2, compensation for impacts to covered species would be achieved through protecting, enhancing, and managing summer and winter habitat. Alternative 2 includes implementing a robust monitoring protocol that provides a high level of certainty for testing the minimization measures and estimating the potential take of covered species.

2.2.3 Alternative 3: Applicant's Proposal (3.0 m/s Cut-in Speed with Feathering: ITP Issuance, HCP with Minimization and Mitigation Measures)

Under Alternative 3, the Service will issue an ITP to authorize incidental take of 2 Indiana bats and 2 northern long-eared bats per year associated with the Project operation. Hoopeston Wind will implement an HCP that includes:

1) Operational measures to reduce take of listed bats;
2) Off-site conservation measures to mitigate the impact of incidentally taking Indiana bats and northern long-eared bats through protection, enhancement, and management of suitable habitat;
3) Post-construction monitoring and adaptive management plan to measure effectiveness of minimization measures and validate incidental take estimates; and
4) Monitoring and adaptive management plan to deal with uncertainties related to minimizing take and mitigating potential impacts of take.

Hoopeston Wind will also implement the BBCS (Appendix A) to reduce the potential for impacts to migratory birds and non-listed bats. However, the monitoring proposed in the BBCS will be replaced by the monitoring plan for covered species, and the conservation measures in the BBCS that address listed and non-listed bats will be replaced by the conservation measures proposed in the HCP.

2.2.3.1 Operational Minimization Measures

In the absence of the operational minimization measures described below, the Applicant estimates the Project would take 2 Indiana bats and 3 northern long-eared bats annually. In other words, absent the feathering strategy with freewheeling turbines, the Project could take approximately 60 Indiana bats and 90 northern long-eared bats over the 30-year term of the ITP.

Under Alternative 3, turbines will be feathered up to the manufacturer's rated cut-in speed (3.0 m/s) for the periods from April 1 through October 15. Curtailment studies have shown feathering below the manufacturer's cut-in speed of 3.0 m/s reduces overall bat mortality by at least 35% (Good et al. 2012, Young et al. 2011, Baerwald et al. 2009). Therefore, feathering at wind speeds up to 3.0 m/s cut-in speeds during the entire bat-active season is expected to reduce the annual take of Indiana bats and northern long-eared bats. Hoopeston Wind is seeking an ITP that authorizes the estimated take of 60 Indiana bats and 60 northern long-eared bats.

2.2.3.2 Mitigation

Under Alternative 3, Hoopeston Wind will implement mitigation measures to compensate for the impact of the taking of Indiana bats and northern long-eared bats (see Section 7.2.2 in the Project HCP for a description of the impact of the taking and the objectives of the mitigation). The Applicant used the Service's Indiana bat REA Model to assess the impact of proposed take on listed bat species, and calculated that 150 acres of forested bat habitat restoration and/or enhancement would fully offset the impact of the taking of either species. Because both species occupy very similar habitat and are often found co-inhabiting the same habitat, the mitigation for the taking of both species is proposed on the same mitigation acres. However, the applicant has added an additional ten percent of the needed mitigation to account for the possibility of competition for foraging resources between the species.

Hoopeston Wind proposes to fund one or more conservation projects for Indiana bats and northern long-eared bats, for a total of 165 acres of forested bat habitat mitigation. Hoopeston Wind will deposit $495,000 into an escrow account that will be used to fund the mitigation. Hoopeston Wind will identify 165 acres of habitat that would benefit from enhancement/restoration and/or protection activities and will provide a mitigation plan to the Service for approval. Enhancement and restoration could include, but may not be limited to, tree planting and management, installation of habitat features (e.g., BrandenBark©), native prairie plantings, mowing around trees to reduce competition and impede weed growth, stand thinning, girdling to create roost trees, understory thinning, invasive species control, prescribed fire, selective harvesting, and/or supplemental plantings. The goal of the mitigation project is to support recovery plan-based conservation projects on no less than 165 acres of land for Covered Species within Illinois, in the Embarras River Watershed or other occupied watershed in proximity to the Hoopeston Wind Project. Also, the mitigation plan will comply with the objectives identified in Section 7.2.2 of the HCP and follow the Mitigation Project Criteria (Appendix B) of the HCP.

Wooded habitats in the region of the Project are limited. Forest restoration efforts (which include permanent protection as well) in this landscape are expected to be equal in value to preservation measures. Hence, a combination of restoration or protection totaling 165 acres would be sufficient based on the estimated impact of take and the stacking of mitigation credits such that mitigating for the impact of take on Indiana bats is sufficient for the northern long-eared bats as well.

Hoopeston Wind will develop and finalize the mitigation plan in consultation with the Service within five months of issuance of the ITP. The plan will set forth the schedule and sequencing for specific habitat enhancement activities to be undertaken. Hoopeston Wind will use the goals, objectives, and guidelines listed in Section 7.2.2 of the HCP and the Mitigation Project Criteria (Appendix B) of the HCP in developing the mitigation plan.

2.2.3.3 Fatality Monitoring

Section 7.3 of the Project HCP describes the Applicant's proposed protocol for mortality monitoring and reporting. Hoopeston Wind is currently conducting post-construction monitoring under the protocols outlined in the Project's BBCS (Appendix A) and in accordance with the requirements of the TAL issued for the Project on March 4, 2014 (Appendix G). Table 7-1 in the Project HCP summarizes the monitoring schedule and protocols. Post-construction monitoring under the ITP will involve intensive monitoring, annual monitoring, check-in monitoring, and adaptive management monitoring if triggered. Each monitoring type is described briefly below. Monitoring will address all bat fatalities observed within the Project area, and fatality estimates will be made based on the number of carcasses detected.

Intensive Monitoring (Years 1-3)

The Applicant used the Evidence of Absence software (Dalthorp et al. 2014) to develop the intensive monitoring schedule and effort. After the ITP is issued, intensive monitoring will occur in Years 1-3 in the spring and fall.

From April 1 through May 15, monitoring efforts will search roads and pads at 44 turbines (90%) and full plots at 5 turbines (10%) once a week. From July 15 through October 15, monitoring efforts will search roads and pads at 34 turbines (70%) and full plots at 15 turbines (30%) twice a week. This is expected to result in an overall detection probability of 0.292 and a 90% confidence that 6 or fewer Indiana bats and 6 or fewer northern long-eared bats are taken during the first 3 years of operation under the ITP. This assumes that no listed bats are actually recovered during the intensive monitoring. If a covered species is found, adaptive management will be implemented as summarized in Section 2.2.3.4 below and explained in detail in Section 7.4 of the Project HCP.

Annual Monitoring (Years 4-14 and Years 17-30)

Annual monitoring is described in Section 7.3.4.1.2 of the Project HCP and will occur during those years in which there is no intensive or check-in monitoring (i.e., years 4–14 and 17–30 of the ITP). Hoopeston Wind will conduct annual monitoring consisting of weekly searches on roads and pads at all 49 turbines from April 1 through October 15. Hoopeston Wind operations staff or a qualified consultant may conduct annual monitoring.

Check-in Monitoring (Years 15-16)

Check-in monitoring is described in Section 7.3.4.1.3 of the Project HCP. A qualified environmental consulting firm will conduct check-in monitoring. Check-in monitoring will occur in spring and fall seasons of years 15 and 16 of the ITP. It will consist of weekly searches of full plots at 5 turbines (10%) and roads and pads at 44 turbines (90%) from April 1 through May 15 and twice weekly searches of full plots at 5 turbines (10%) and roads and pads at 44 turbines (90%) from August 1 through October 15.

Adaptive Management Monitoring

If adaptive management is triggered, as described in Section 7.4 and Section 8.1.2.5 of the Project HCP, Hoopeston Wind will implement adaptive management monitoring (see Table 7-2, Table 7-3, and Table 8-1 in the Project HCP). Adaptive management monitoring will consist of searches conducted 3 times each week for 2 additional years within the season when adaptive management was triggered. Searches will occur at roads and pads out to 95 meters (312 feet) at all 49 turbines.

2.2.3.4 Adaptive Management

Hoopeston Wind will use adaptive management to minimize take associated with the operation of the Project and promote the long-term survival of both Indiana bats and northern long-eared bats. Hoopeston Wind's adaptive management strategy is described in Section 7.4 and summarized in Table 7-3 of the Project HCP.

If no take of covered species is calculated or detected or analysis of monitoring data indicates authorized take of covered species has not been exceeded, then Hoopeston Wind will continue their proposed operational program during the remaining term of the ITP.

If covered species are discovered during the first 3 years of monitoring or during annual check-in monitoring, Hoopeston Wind will notify the Service within 48 hours of positive species identification (or in the case of a suspect carcass) to evaluate available data concerning the discovery, potential cause of the fatality, and appropriate adaptive management actions to be implemented if necessary consistent with the HCP. If no covered species are observed, Hoopeston Wind will use both species composition and the Evidence of Absence software (Dalthorp et al. 2017) to estimate fatalities of covered species, as explained in Section 7.3.5.1 of the Project HCP. Both methods of fatality estimation have unique sensitivities and biases, and Hoopeston Wind will coordinate with the Service to evaluate these estimates and determine if they comply with the ITP. Table 7-2 and Table 7-3 in the Project HCP outline the specific adaptive management triggers and responses in view of carcass discoveries and associated Indiana bat and northern long-eared bat fatality estimates.

Hoopeston Wind will also cooperate with the Service in determining when adaptive management is triggered. All changes in operational protocols triggered by adaptive management will be conducted in conference with the Service.

2.2.3.5 Alternative 3 Summary

Within the context of this Project, the Applicant's Proposal meets the Service's purpose to ensure ESA compliance for the Project to avoid, minimize, and mitigate take of listed species and legally authorize the incidental take of the Indiana bat and northern long-eared bat consistent with permit issuance criteria (section 10(a)(1)(B) of the ESA) and associated implementing regulations [50 CFR 17.22(b)(2) and 17.32(b)(2)]. The Service's goal within the context of the permit application is to conserve the Indiana bat and northern long-eared bat and their habitats in the Plan area and region for the continuing benefit of the people of the United States. Alternative 3 will include mitigation designed to fully off-set the impacts of taking both covered species. Alternative 3 will include a robust monitoring protocol that provides a high level of certainty for testing the minimization measures and estimating the Project's take of listed species.

2.3 ALTERNATIVES ELIMINATED FROM DETAILED ANALYSIS

NEPA requires that federal agencies thoroughly consider and objectively evaluate all reasonable alternatives and briefly explain the basis for eliminating those alternatives that were not retained for detailed analysis (40 CFR 1502.14). Early discourse between the Service and the Applicant on potential minimization and mitigation measures resulted in an initial list of potential alternatives for achieving the purpose and need of the Project. Some of these alternatives were later determined to not meet the purpose and need of either the Service or Applicant. Other alternatives could not be legally undertaken, or were found to be lacking in sufficient protection for the covered species or other wildlife resources, or included conservation measures that were not practicable given the magnitude of potential effects. Also, some alternatives, if implemented, would not result in any detectable differences in impacts to covered species. Therefore, the alternatives described below were considered but eventually dismissed from detailed analysis for reasons summarized below.

2.3.1 ITP with Full Implementation of HCP and Reduced Permit Term (5 years)

The Reduced Permit Term Alternative would be implemented as described for Alternative 3 with an ITP term for 5 years as opposed to 30 years. The HCP would also be modified to reflect implementation for a 5-year period. Upon nearing the end of the 5-year period, Hoopeston Wind would seek an extension of the ITP if they deemed it necessary. The length of the renewal period would be decided at the time of renewal and based on the results of the post-construction monitoring and any adaptive management implemented. At the time of the request for a permit renewal, greater certainty would be known about the effectiveness of turbine operational curtailment measures to reduce bat fatalities. The initial permit would authorize less take than Alternative 3, but if renewed, would likely have similar long-term effects as Alternative 3, even in light of its adaptive management strategy.

Under this Alternative, an ITP would be issued contingent upon implementation of the conservation plan set forth in the Project HCP. Therefore, this alternative would meet the Service's purpose to provide a means to protect the Indiana bat and northern long-eared bat and habitats within the context of the Project. The Reduced Permit Term Alternative also meets the Agency's goals of minimizing and mitigating take of Indiana bats and northern long-eared bats.

This Alternative does not meet the Applicant's purpose and need because a permit of such short duration provides no assurances that additional permits would be re-issued repeatedly for the life of the Project. Additionally, this puts a considerable financial and labor-intensive burden on the Applicant to repeat the permitting process numerous times.

This alternative would not reduce further any estimated annual take, would create an additional administrative burden, and would likely have similar long-term biological effects as Alternative 3. The annual review process outlined in the Project HCP provides for a system of checks and balances for reducing uncertainty regarding the effectiveness of operational curtailment. This review process would implement procedures for evaluating the effectiveness of the HCP and ensuring that take levels specified in the ITP are not exceeded. Because it does not provide substantially different protection for Indiana bats and northern long-eared bats beyond what is proposed in the Project HCP, this alternative was eliminated from consideration.

2.3.2 Variations in Operational Cut-in Speeds, ITP Issuance, HCP with Minimization and Mitigation Measures

Based on review of publicly available research, the Service considered several alternatives that would implement cut-in speeds that fall between the cut-in speeds employed in the two action alternatives (>3.0 m/s but <5.0 m/s) and cut-in speeds that are greater than those employed in Alternative 2 (>5.0 m/s but <6.9 m/s). Specifically, these alternatives included feathering at all turbines at 3.5 m/s, 4.0 m/s, 4.5 m/s, 5.5 m/s, 6.0m/s, or 6.5 m/s cut-in speeds from August 1 to October 15.

Studies conducted at wind projects in a variety of landscapes have demonstrated that seasonal changes in cut-in speeds and blade feathering can affect bat mortality rates (Figure 2-1). There is a wide-range of factors influencing the results from each study (i.e., searcher efficiency rates, carcass removal rates, number of migrating bats, plot size, sample size of bat carcasses found, number of turbines in each treatment, probability of carcass detection, etc.). Not only do percent reductions overlap from study to study, but confidence intervals of treatment results often overlap within a study. Because of these uncertainties and confounding factors, it is difficult to accurately identify differences in bat mortality reductions for any project as a result of small changes in cut-in speeds. Furthermore, when percent reductions from the studies are applied to the small take numbers calculated for the Project (baseline take estimates with no feathering), the differences among potential cut-in speed regimes are fractions of bats annually. Figure 2-2 illustrates this for the Indiana bat.

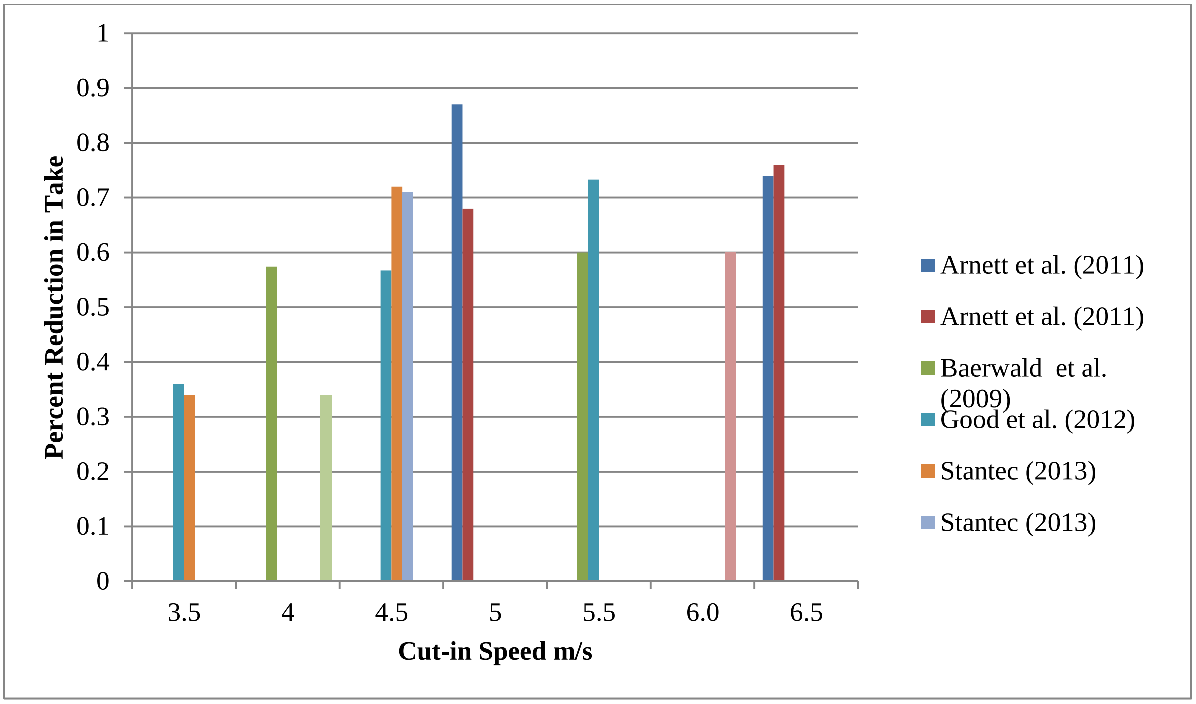

Figure 2-1. Percent reduction in bat mortality rates observed at six curtailment studies.

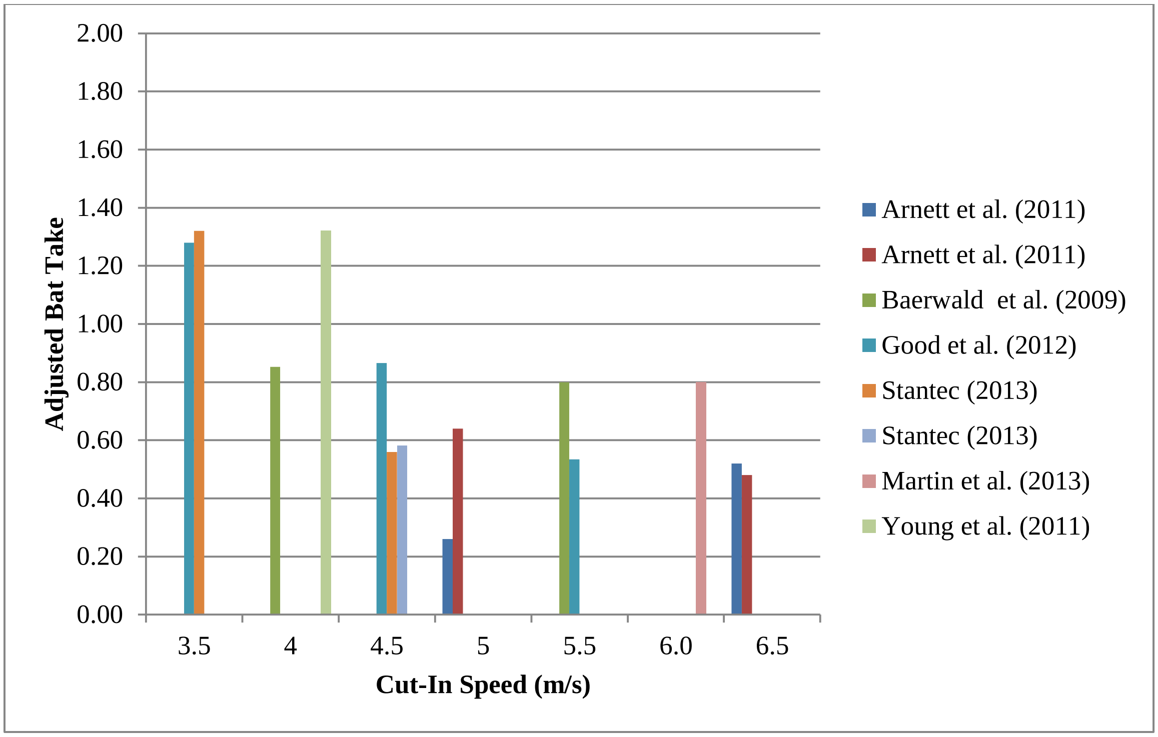

Figure 2-2. Estimated annual take of Indiana bats at the Hoopeston Wind Project resulting from the implementation of different cut-in speeds.

For comparison, Table 2-1 lists the expected kilowatt hours of energy lost as a result of implementing different cut-in speeds.

Table 2-1. Estimated energy loss and carbon dioxide (CO_2) increases for cut-in speed curtailment levels for the Hoopeston Wind Project between August 1 and October 15, assuming a 30-year permit duration.

Fall Cut-in Speed	Energy Losses (kilowatt hours)	CO_2 Increases (metric tons)[1]
6.9 m/s	5,326,000	3,743.0
6.5 m/s	3,772,000	2,651.0
6.0 m/s	2,418,000	1,699.0
5.5 m/s	1,411,000	992.0
5.0 m/s	768,000	540.0
4.5 m/s	368,000	259.0
4.0 m/s	141,000	99.1
3.5 m/s	41,000	28.8
3.0 m/s	0	0

[1] Based on USEPA (2016).

The current body of literature does not allow us to calculate meaningful differences for small adjustments in cut-in speeds. However, those same incremental adjustments in cut-in speeds do result in measurable and substantial losses in renewable energy production. Given this, our alternatives carried forward for detailed analysis are those for which there are the widest differences in impacts to covered species and those that would allow us to better understand the differences to bat mortality under different cut-in speeds, while allowing for more renewable energy production.

2.4 SUMMARY OF THE ALTERNATIVES ANALYSIS

Reasonable alternatives determined to minimize and mitigate adverse effects to Indiana bats and northern long-eared bats and other resources were compared and contrasted based on results of the detailed analysis. Table 2-2 summarizes those elements that would vary among the No-Action and each action alternative.

Table 2-2. Summary of alternatives retained for detailed analysis.

1.40 Indiana bats and 1.65 northern long-eared bats per year. Over the 30-year permit term, the Project could incidentally take 42.0 Indiana bats and 49.5 n

Alternative	Operations	Monitoring	ITP / Implement HCP	Implement BBCS	Incidental Take
1. No-Action	**49 turbines feathered at 6.9 m/s** cut-in speed from August 1 through October 15 from sunset to sunrise for life of Project	**Spring/Fall Years 1-3:** 49 turbines weekly on roads and pads, 5 turbines weekly on cleared plots; follow-up based on initial results	No	Yes	None expected
2. 5.0 m/s & 3.0 m/s (Mixed Operations)	**49 turbines feathered at 3.0 m/s** cut-in speed from October 16 through July 31 from sunset to sunrise **29 turbines feathered at 5.0 m/s** cut-in speed and **20 turbines feathered at 3.0 m/s** cut-in speed from August 1 through October 15 from sunset to sunrise when ambient temperature is above 10°C based on a 10-minute rolling average	**Fall Years 1-3:** 2x weekly; 15 full plots, 34 roads/pads **Spring Years 1-3:** 1x weekly; 5 full plots, 44 roads/pads **Annual Years 1-30:** 1x weekly; 49 roads and pads **Fall Years 15 & 16:** 2x weekly; 5 plots, 44 roads/pads **Spring Years 15 & 16:** 1x weekly; 5 full plots, 44 roads/pads	Yes	Yes	Indiana bat = 1.57/year; 47.1 over 30 years Northern long-eared bat; = 1.85/year; 55.5 over 30 years
2. 5.0 m/s Option	**49 turbines feathered at 3.0 m/s** cut-in speed from October 16 through July 31 from sunset to sunrise **49 turbines feathered at 5.0 m/s** cut-in speed from August 1 through October 15 from sunset to sunrise when ambient temperature is above 10°C based on a 10-minute rolling average	**Fall Years 1-3:** 2x weekly; 15 full plots, 34 roads/pads **Spring Years 1-3:** 1x weekly; 5 full plots, 44 roads/pads **Annual Years 1-30:** 1x weekly; 49 roads and pads **Fall Years 15 & 16:** 2x weekly; 5 plots, 44 roads/pads **Spring Years 15 & 16:** 1x weekly; 5 full plots, 44 roads/pads	Yes	Yes	Indiana bat = 1.40/year; 42.0 over 30 years Northern long-eared bat; = 1.65/year; 49.5 over 30 years

Alternative	Operations	Monitoring	ITP / Implement HCP	Implement BBCS	Incidental Take
3: 3.0 m/s (Applicant's Proposal)	**49 turbines feathered at 3.0 m/s** cut-in speed from April 1 through October 15 from sunset to sunrise	**Fall Years 1-3:** 2x weekly; 15 full plots, 34 roads/pads **Spring Years 1-3:** 1x weekly; 5 full plots, 44 roads/pads **Annual Years 1-30:** 1x weekly; 49 roads and pads **Fall Years 15 & 16:** 2x weekly; 5 plots, 44 roads/pads **Spring Years 15 & 16:** 1x weekly; 5 full plots, 44 roads/pads	Yes	Yes	Indiana bat = 1.30/year; 39 over 30 years Northern long-eared bat = 1.9/year; 58.5 over 30 years[1]

[1] These values are the Applicant's estimated take. Note, the Applicant is proposing a take limit of 2 Indiana bats and 2 northern long-eared bats per year and seeking authorized take of 60 Indiana bats and 60 northern long-eared bats.

CHAPTER 3. AFFECTED ENVIRONMENT

The affected environment is the area and its resources (i.e., physical, biological, socio-economic) potentially impacted by the proposed action and alternatives. The purpose of describing the affected environment is to define the context in which the impacts will occur. To make an informed decision about which alternative to select, it is necessary to first understand which resources will be affected and to what extent. The affected environment section of this document attempts to provide the basis for this understanding.

Relative to the Applicant's proposal, the affected environment includes those settings where any covered activities will occur, i.e., the covered lands. The covered lands for Hoopeston Wind's HCP are defined as the Project area (Figure 1-1 and Figure 1-2), which is 8,884 acres, and the area within the outermost boundary of the properties belonging to participating landowners. The ITP will cover the Project area, the site of Project operations, and all covered activities, i.e., maintenance, mortality monitoring, and decommissioning.

In defining potentially affected resources, we considered the potential impacts associated with the Proposed Action and alternatives, namely potential issuance of an ITP to Hoopeston Wind for take of Indiana bats and northern long-eared bats and implementation of the associated HCP. The alternatives under consideration include 3 different conservation scenarios for potential covered activities (i.e., different operational regimes involving turbine blade feathering and cut-in speeds) designed to avoid and minimize take of the covered species, including measures designed to mitigate impacts associated with species take. Therefore, the analysis of impacts in this EA is directed at those resources potentially affected by the proposed covered activities, and that are attributable to the Services proposed action. In other words, our analysis focused on the difference between the environmental impacts caused by the applicant's otherwise non-federal activities (i.e., operation of a wind farm without the need for an ITP and associated HCP) and those same activities "covered" in the HCP (i.e., associated with a species conservation measure) and for which incidental take would be authorized through issuance of a permit. The "net impact", or differences among the proposed action, action alternatives, and no-action alternative, is what is factored into our significance determinations. With regard to implementation of any of the alternatives considered, bat and bird resources are likely to experience the most pronounced impact, and only bat mortality is likely to vary among alternatives. As such, our analysis focuses primarily on these two resources.

3.1 OVERVIEW OF THE PROJECT AREA

The Project is located in Vermilion County in eastern Illinois, southwest of the city of Hoopeston and west of the village of Rossville. The Project area extends to the outermost boundary of the parcels leased for the Project and covers 8,884 acres (Figure 1-1). The landscape is crisscrossed by a network of local and state roads, open ditches and subsurface tiled drains, and electrical power lines. On the leased parcels, private landowners will continue their current land uses in conjunction with the wind development. Nearby small towns include Henning, Potomac, Armstrong, Penfield, Clarence, Rankin, and East Lynn.

The Project is situated in the Till Plains section of the Central Lowland physiographic province (Illinois State Geological Survey 2015) amidst flat to gently rolling topography produced by glacial processes.

Elevations within Vermilion County range from 290 to 720 feet above mean sea level. There is minimal topographic relief in the Project area.

Perennial and intermittent streams and drainages are common across the landscape. Perennial streams within the Project area include Bluegrass Creek, Fountain Creek, and several mapped, unnamed creeks (Figure 3-1), all of which drain to larger waterways located outside of the Project area, the Wabash River and the North and Middle Forks of the Vermilion River. National Wetlands Inventory data (USFWS 2015*a*) indicate small wetlands scattered throughout the Project area, primarily associated with the creeks. Forested areas within the Project area are limited to narrow bands of trees and shrubs or small woodlots often associated with field edges, property lines, streams, drainages, or wetlands (Figure 3-2).

The 98-MW Project comprises 49 wind turbine generators, underground power collection lines, substation, switchyard, operations and maintenance building, access roads, and a permanent MET tower. The Project interconnects with a 138-kV transmission line owned by the Illinois utility subsidiary of Ameren Illinois Corporation. As a leaseholder, Hoopeston Wind's rights are limited to those incorporated in the lease agreement with each landowner, which allow for safe and effective construction, operation, maintenance, and decommissioning of the Project. Hoopeston Wind has no control over landowner activities on the properties on which the Project is located to the extent not covered in specific lease provisions.

Construction began in spring 2014, and Hoopeston Wind used standard procedures and best management practices to minimize impacts to the existing environment and habitat during construction. The Project began operations in March 2015.

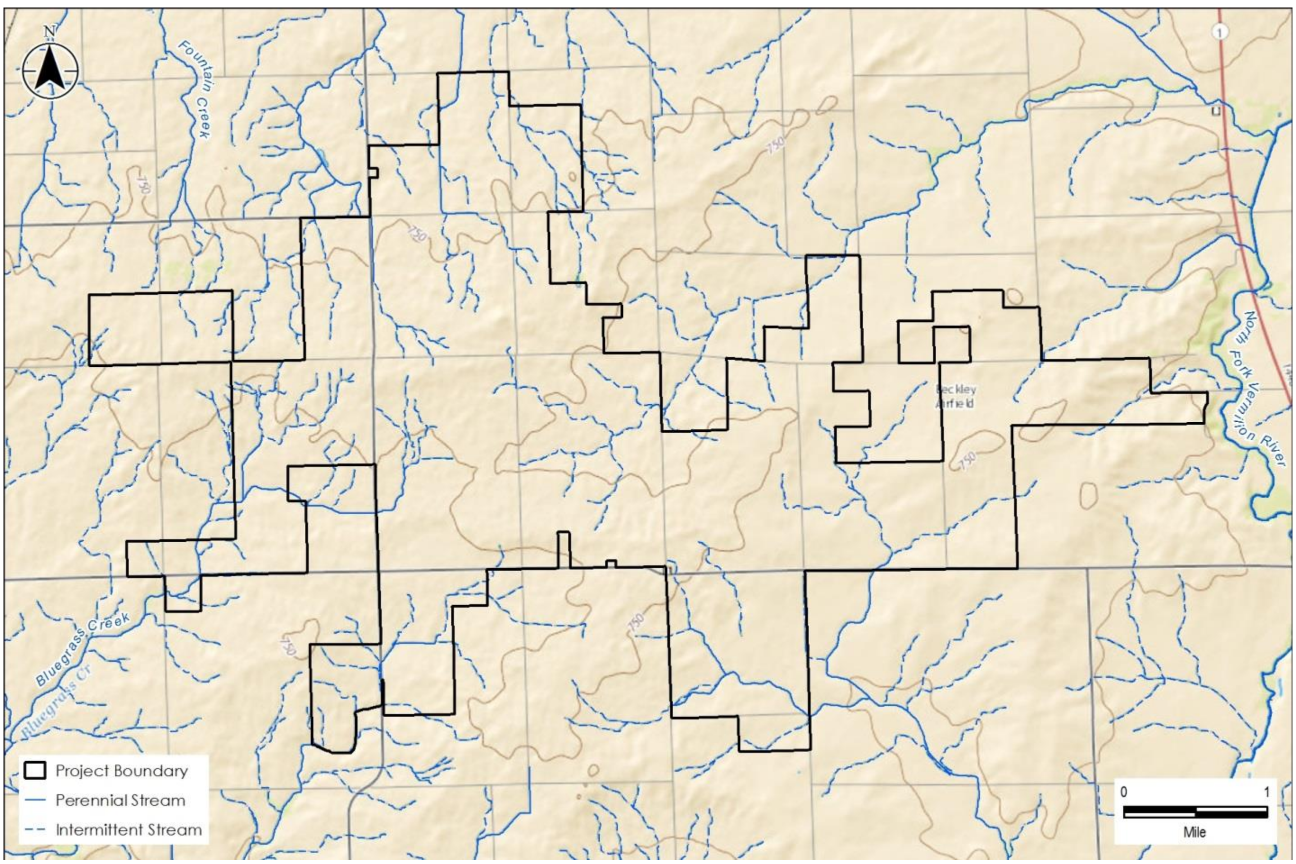

Figure 3-1. Perennial and intermittent streams within the Project area include Bluegrass Creek, Fountain Creek, and several unnamed creeks.

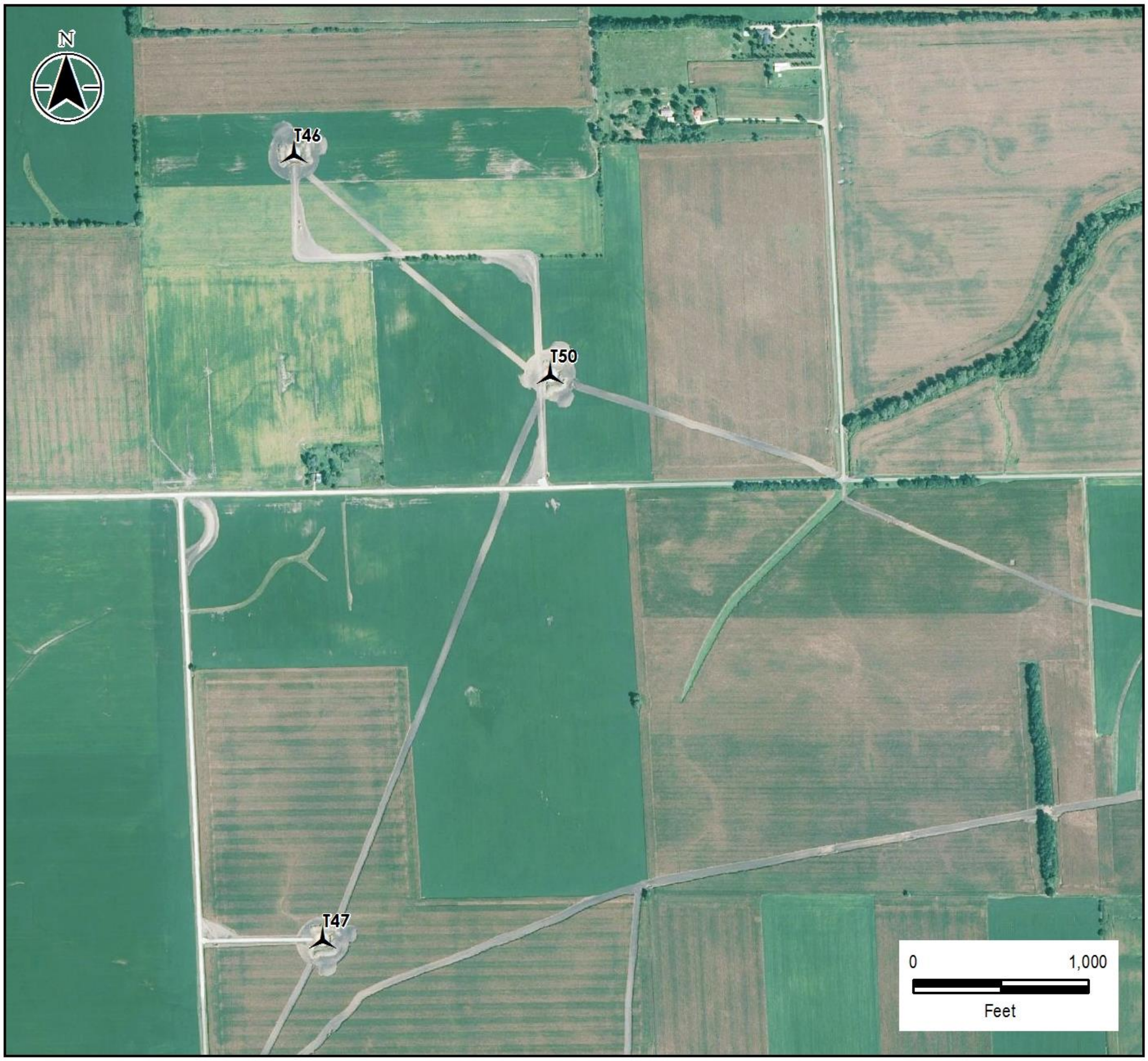

Figure 3-2. **An aerial view of the Project in the vicinity of Turbines 46, 47, and 50. Forested areas within the Project area are limited to narrow bands of trees and shrubs or small woodlots.**

3.2 PHYSICAL ENVIRONMENT

3.2.1 Air Quality and Climate

The Clean Air Act (CAA) 42 U.S.C. §7401 et seq. (1970) is a comprehensive federal law that regulates air emissions from stationary and mobile sources. The CAA law authorizes the U.S. Environmental Protection Agency (USEPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and welfare and regulate emissions of hazardous air pollutants. However, it is the responsibility of each state to develop and implement a plan for maintaining and enforcing the USEPA's established NAAQS.

We used data from the Illinois Environmental Protection Agency's (IEPA) 2013 air monitoring report (IEPA 2013) to assess air quality conditions relative to the Project. No air quality monitoring sites are located in Vermilion County. The monitoring stations closest to the Project, Thomasboro and Champaign monitoring stations in Champaign County, are located approximately 21 miles and 28 miles from the Project, respectively. The Thomasboro station monitored only ozone in 2013. At this station in 2013, ozone was not detected at levels exceeding established standards (IEPA 2013). The Champaign station monitors only fine particulates (particulate matter 2.5 or $PM_{2.5}$). At this station in 2013, detection of fine particulates did not exceed established standards (IEPA 2013). Based on the available information, the air quality in the Project area meets the required standards for all monitored criteria pollutants.

Greenhouse gases (GHG) are gases that warm the earth's atmosphere by absorbing solar radiation reflected from the earth's surface. As per CEQ guidelines, GHGs include are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and sulfur hexafluoride (SF_6) (CEQ 2016). According to IPCC (2013), scientists find that increasing GHG concentrations are warming the planet, and rising temperatures may, in turn, produce changes in precipitation patterns, storm severity, and sea level — a phenomenon commonly referred to as "climate change."

The combustion of fossil fuels to generate electricity is the largest single source of CO_2 emissions in the U.S., accounting for 37% of the nation's total energy-related CO_2 emissions and 31% of the nation's total GHG emissions in 2013 (USEPA 2015). In 2014, the U.S. obtained about 67% of its electricity from fossil fuels, with 39% of that coming from coal (USEIA 2015a). CO_2 emissions depend on the source of energy and its carbon content. Coal has the highest carbon content per unit of electricity produced of all fossil fuels used to generate electricity in the U.S. (USEPA 2015). Coal-fired power plants account for approximately 77% of CO_2 emissions from power plants in 2013 (USEPA 2015). In Illinois, approximately 46% of electricity generated in 2013 was produced from coal (USEPA 2015). In 2012, Illinois ranked sixth in the nation in total CO_2 emissions produced annually, following Texas, California, Pennsylvania, Florida, Ohio, and Louisiana (USEPA 2015).

Project operations require a relatively small amount of vehicular traffic resulting in the release of CO_2 emissions and particulates. These emissions are not estimated to have a significant effect on local or regional air quality or contribute greatly to the amount of GHG emissions. Project operations do not generate any new sources of air pollutants.

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Wildlife Resources

This section addresses non-volant wildlife; birds and bats are addressed in Sections 3.3.2 and 3.3.3 General wildlife includes common terrestrial animals and rare, threatened, and endangered animals. Project operations are likely to affect wildlife resources. The Project area does not possess sufficient aquatic resources to support fish.

3.3.1.1 Habitat Conditions for General Wildlife

Project Area

Much of the Project area (roughly 95%) is used for the production of cultivated crops. The remaining 5% of the Project area is developed. Deciduous forest makes up less than 0.1% of the Project area. Forested areas are small, linear patches of forest or are associated with larger streams (IGD 2000 as cited in the Project HCP). The only water resources in the Project area are Bluegrass Creek tributary and small, unnamed tributaries associated with the North Fork Vermilion River (Project BBCS).

Terrestrial Wildlife

Terrestrial wildlife expected to occur in the Project area are generalist species adapted to an agricultural environment.

Mammal species present at the Project may include coyote (*Canis latrans*), white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), squirrels (*Sciurus* spp.), eastern cottontail (*Sylvilagus floridanus*), eastern mole (*Scalopus aquaticus*), and meadow vole (*Microtus pennsylvanicus*).

Creeks and drainages in the Project area may be used by amphibians such as American toad (*Anaxyrus americanus*) and Fowler's toad (*Bufo woodhousii fowleri*), and reptiles, such as painted turtle (*Chrysemys picta*), Texas rat snake (*Pantherophis obsoletus*), and garter snake (*Thamnophis sirtalis*).

3.3.1.2 Rare, Threatened, and Endangered Wildlife

Federally listed species are afforded protection under the ESA. In Illinois, state-listed species are afforded protection under the Illinois Endangered Species Protection Act (520 ILCS 10). Indiana bats and northern long-eared bats are the only federally listed species with potential to occur in the Project area. Indiana bats and northern long-eared bats are also listed as endangered and threatened in Illinois, respectively, and are addressed in Section 3.3.3. The state-listed species with records of occurrence in Vermilion County include Franklin's ground squirrel (*Spermophilus franklinii*), Blanding's turtle (*Emydoidea blandingii*), smooth softshell (*Apalone mutica*), silvery salamander (*Ambystoma platineum*), and four-toed salamander (*Hemidactylium scutatum*) (based on review of IDNR 2015).

Franklin's Ground Squirrel

The Franklin's ground squirrel, a state-listed threatened mammal, occurs primarily in the Great Plains (Hall 1981 as cited by Martin et al. 2003). Suitable habitat in the southeastern part of their range, in Illinois and Indiana, consists of remnant tallgrass prairie, woodland edges and openings, and stands of tall, dense grasses, forbs, and shrubs. In agricultural landscapes, suitable habitat can be found among fencerows, old fields, infrequently mowed roadsides and waste places, and the banks of ditches and railroad rights-of-way (Martin et al. 2003). Franklin's ground squirrel feeds on vegetation, cultivated grains and garden vegetables, fruits and seeds from plants including grass, thistle, dandelion, clover, and blackberry, and insects (Kurta 1995).

In the Project area, suitable habitat for Franklin's ground squirrel is restricted to roadsides and waste places; there is little suitable habitat in the Project area capable of supporting this species. Cultivation practices throughout the Project area, such as pesticide application, limit the insect prey and weed seed food sources for this species.

Blanding's Turtle

Blanding's turtle, an Illinois endangered species, inhabits shallow, quiet waters and ponds, swamps, weedy marshes, and lake backwaters. The main part of its range extends from southwestern Quebec and southern Ontario south through the Great Lakes and west to Iowa, northeastern Missouri, southeastern South Dakota, and west central Nebraska. It also occurs in scattered locations in southeastern New York, eastern Massachusetts, southern New Hampshire and Maine, and Nova Scotia. They are semi-aquatic, laying eggs in burrowed nests in sandy, loose soils during the late spring. They are often found basking on logs and other emergent objects in wetlands, or burrowed into cool mud during hot weather. They feed primarily on aquatic and terrestrial animals including earthworms, leeches, snails, millipedes, crayfish, and insects (Ernst and Lovich 2009). One of Illinois' largest populations of nesting Blanding's turtles is found in a 302-acre wetland complex approximately 130 miles northwest of the Project within the Illinois Audubon Society's Amboy Marsh Wildlife Sanctuary (Illinois Audubon Society, not dated).

In the Project area, suitable habitat for Blanding's turtle is restricted to the Bluegrass Creek tributary and small, unnamed tributaries of the North Fork Vermilion River. The lack of suitable habitat within the Project area makes it unlikely for this species to occur.

Smooth Softshell

Smooth softshell, an Illinois endangered species, inhabits open waters of medium-sized and large rivers and streams with moderate to fast currents. Its range includes the Ohio River drainage, upper Mississippi watershed from Minnesota and Wisconsin, and the Missouri River of the Dakotas south to the Florida Panhandle and west to central Texas (Ernst and Lovich 2009). There is also an isolated population in northeastern New Mexico. They feed largely on insects, but will also consume other animals and plant materials at times (Ernst and Lovich 2009) including crayfish, snails, worms, fish, amphibians (Collins 1982 as cited by MNDNR 2015), clams, isopods, spiders, and some plant material. They catch their prey both in the water and on land (Ernst and Lovich 2009).

In the Project area, suitable habitat for smooth softshell is restricted to the Bluegrass Creek tributary and small, unnamed tributaries associated with the North Fork Vermilion River. The lack of suitable large riverine habitats within the Project area makes it unlikely for this species to occur.

Silvery Salamander

Silvery salamander, an Illinois endangered species, is a genetically complicated species of mole salamander originally thought to belong to a single population in Kickapoo State Park in Vermilion County. Recent research has discovered they occur elsewhere in Vermilion County and also in Crawford County but in very limited areas (INHS 2015*a*). Adults are terrestrial and spend most of the summer and winter underground. In the spring, adults migrate to ponds to breed. Adults feed on beetles, centipedes, slugs, worms, and other invertebrates.

In the Project area, suitable habitat for silver salamander is restricted to the Bluegrass Creek tributary and small, unnamed tributaries associated with the North Fork Vermilion River undisturbed by agricultural practices. The lack of suitable breeding habitat and disturbed terrestrial habitat makes the Project area unlikely to support this species.

Four-toed Salamander

Four-toed salamander, an Illinois threatened species, inhabits boggy pools or spring-fed ravines in undisturbed deciduous forests that are relatively mature. They are known to occur in soggy soil below dams of man-made lakes (INHS 2015*b*). Terrestrial adults feed on arthropods on the forest floor. The female lays eggs a few inches above the water in mats of moss or leaves, on logs, under rocks, or along the banks of spring-fed streams or pools.

In the Project area, suitable habitat for four-toed salamander is restricted to the Bluegrass Creek tributary and small, unnamed tributaries associated with the North Fork Vermilion River. The tributaries may contain suitable habitat, but the Project has not impacted any of these areas.

3.3.2 Avian Resources

3.3.2.1 Scope of Analysis

For the purposes of this EA, the scope of this analysis includes avian resources within the Project area and surrounding regions. Birds are highly mobile, and dispersal and migration are important aspects of their life strategies and survival. Birds will occur within and travel through the Project area while flying to and from natural resources within the surrounding landscape and during migration. All bird species with potential to occur in the Project area are addressed in this section, protected or otherwise.

This analysis considers regional and site-specific habitat and land cover assessment information, publicly available regional databases, and site-specific avian survey data. For the purpose of this EA, analysis of avian resources is based on the following sources:

- Results of pre-construction avian surveys conducted in the Project area in 2009 and 2010 (Appendix B)
- Project BBCS (Appendix A)
- Project HCP
- Illinois Natural Heritage database Illinois threatened and endangered species occurrences by county (IDNR 2015)
- Illinois Natural History Survey Spring Bird Count database (INHS 2012)

3.3.2.2 Project Area

Avian species that occur in the region of the Project area are diverse and use a wide variety of habitats. To facilitate analysis, we considered avian resources based on the following group classifications, which are generalized from the taxonomic orders in the subclass Neornithes, or modern birds:

- Passerines (songbirds and corvids);
- Nocturnal non-passerines (nightjars);
- Shorebirds;
- Waterbirds (waterfowl, loons, grebes);
- Game birds; and
- Raptors (falcons, eagles, hawks), vultures, and owls.

Relative to the Project area, statutes that afford protection to birds are described in Section 1.2. This analysis focuses on species of birds protected under the ESA, BGEPA, and the Illinois Endangered Species Protection Act (520 ILCS 10/), but also considers species that are common to the Project area and region. Abundant species are expected to occur more frequently and are more likely to experience impacts at the Project.

Existing Conditions in the Region

Important Bird Areas

The Audubon Important Bird Areas Program in Illinois has designated 90 locations throughout the state as Important Bird Areas (IBAs), sites of high bird abundance and diversity. There are 2 IBAs in Vermilion County: Kennekuk County Park and Forest Glen County Preserve (National Audubon Society 2013*a*). Kennekuk County Park is approximately 20 miles south of Hoopeston in Danville, Illinois, and the Forest Glen Preserve is 30 miles south of Hoopeston in Westville, Illinois (Figure 3-3).

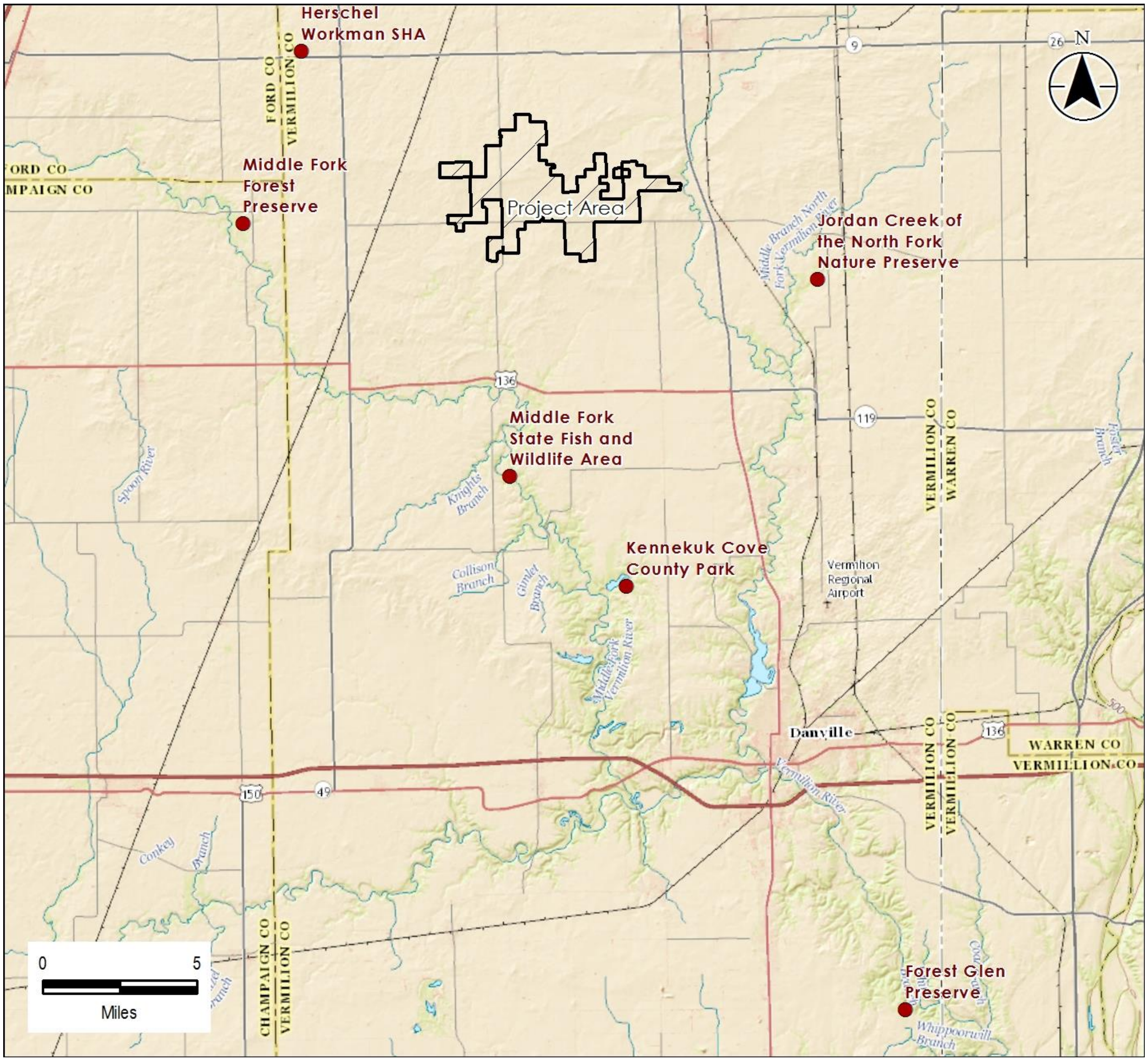

Figure 3-3. **Parks, preserves, and wildlife areas in the region relative to the Hoopeston Wind Project area.**

Kennekuk Cove County Park is a 3,000-acre IBA that has eastern tallgrass prairie, prairie hardwood transition, and central hardwoods. The site has supported confirmed breeding of blue-winged warbler (*Vermivora cyanoptera*) and yellow-breasted chat (*Icteria virens*) (National Audubon Society 2013*b*).

Forest Glen Preserve is a 1,800-acre forest that met the IBA criteria for migrants. Spring migrants include up to 36 species of warblers. Breeding grassland species include sedge wren (*Cistothorus platensis*), Henslow's sparrow (*Ammodramus henslowii*), Savannah sparrow (*Passerculus sandwichensis*), grasshopper sparrow (*Ammodramus savannarum*), eastern meadowlark (*Sturnella magna*), and dickcissel (*Spiza americana*). Species that breed in shrublands include white-eyed vireo (*Vireo griseus*), Bell's vireo (*Vireo bellii*), orchard oriole (*Icterus spurius*), and willow flycatcher (*Empidonax traillii*). Various bird species breed in the forested areas. Long-eared owl (*Asio otus*), short-eared owl (*Asio flammeus*), and northern saw-whet owl (*Aegolius acadicus*) have been observed wintering at this IBA (National Audubon Society 2013*c*).

Illinois Audubon Wildlife Sanctuaries

No wildlife sanctuaries owned by the Illinois Audubon Society intersect the Project area. The closest wildlife sanctuary to the Project area is the Plum Island Eagle Sanctuary, approximately 90 miles to the northeast. This sanctuary is a 45-acre island on the Illinois River across from Starved Rock State Park known to support wintering eagles (Illinois Audubon Society, not dated). The second closest sanctuary is the Margery Adams Wildlife Sanctuary, over 100 miles to the southwest. It has an urban nature center and trail system. There are no sanctuaries for greater prairie-chicken (*Tympanuchus cupido*) near the Project.

Nature Preserves and Wildlife Areas

No nature preserves or wildlife areas intersect the Project area. The closest preserve is the Middle Fork Forest Preserve approximately 10 miles west of the Project area. It includes a 130-acre waterfowl management area on the Middle Fork Vermilion River (Figure 3-3). Jordan Creek of the North Fork Vermilion River is a biologically significant stream (Figure 3-3). This preserve features streams and associated riparian areas, wetlands, mature oak forest, savanna, successional forest, grasslands, a seep, a small pond, and an old orchard. Wildlife occurrences include a variety of passerines and a great blue heron rookery (Johnston and Peverly 2008).

The Middle Fork State Wildlife Area has parcels along the Middle Fork Vermilion River, and the main wildlife area is approximately 8 miles from the Project area (Figure 3-3). The area consists of 2,700 acres of grass, forest, and cropland and provides habitat for waterfowl, shorebirds, egrets, and herons in the bottomland forest.

The Vermilion County Conservation District maintains 7 other Illinois Nature Preserves within Vermilion County, including 3 within Kennekuk County Park, approximately 20 miles south of Hoopeston in Danville, Illinois, and 4 within Forest Glen Preserve 30 miles south of Hoopeston in Westville. Kennekuk County Park includes the 32-acre Windfall Prairie, which has species such as Indian grass (*Sorghastrum nutans*), purple coneflower (*Echinacea* sp.), and juniper (*Juniperus* sp.). It includes Horseshoe Bottoms, encompassing 52 acres of bottomland forest, and Fairchild Cemetery. Forest Glen Preserve encompasses approximately 240 acres including a 160-acre beech/maple forest called Russell Duffin Woods, Forest Glen Seep, and Howard's Hollow Seep featuring species including marsh marigold (*Caltha palustris*) and skunk cabbage (*Symplocarpus foetidus*), and Doris L. Westfall Nature Preserve featuring 100 species of native prairie grasses and forbs (Vermilion County Conservation District, not dated)

HMANA Hawk Watch Sites

Illinois is within the Central Continental Hawk Migration Flyway, as designated by the Hawk Migration Association of North America (HMANA). Pronounced raptor activity occurs along the shorelines of the Great Lakes (Dunne 1984); migrants fly along the southern shorelines in spring and around the northern shorelines in fall. Raptor migration occurs as a broad front across the rest of the flyway, including eastern Illinois, where there are no significant water barriers or ridges that produce favorable updrafts to concentrate migration (HMANA 2006). There are 7 reported HMANA Hawk Watch Sites in Illinois, all near Lake Michigan (HMANA 2015). The closest HMANA Hawk Watch Site to the Project is at the site of a closed landfill at the Greene Valley Forest Preserve, approximately 100 miles north of Hoopeston. In September, October, and November 2014, observers documented 3,842 raptors, most of which were broad-winged hawks (*Buteo platypterus*; 1,596; 42%) followed by red-tailed hawks ((*Buteo jamaicensis*; 682; 18%). Observers also documented 64 northern harriers (*Circus cyaneus*; HMANA 2014).

Eagles

In Illinois, the bald eagle population continues to increase, and the Service recently reported nesting in 49 counties (USFWS 2015*b*). Large numbers of bald eagles winter primarily along the Mississippi, Rock, and Illinois rivers in the state, all of which are more than 100 miles from the Project area. Bald eagles occur in large numbers on the Wabash River in Indiana on Mississinewa Lake and J. Edward Roush Lake (Recreation.gov 2014), both of which are more than 80 miles from the Project. However, anecdotal observations have found individual bald eagles throughout the state in winter. The population trend for wintering bald eagles will fluctuate with weather conditions, but recent counts have indicated stable to increasing numbers (based on Audubon Christmas Bird Count data).

Existing Conditions in the Project Area

Potential resources for avian species include tilled row-crop fields that may be used by shorebirds, blackbirds, and waterfowl as over-wintering habitat and stopover habitat during migration. Tilled crop-fields also provide foraging opportunities for raptors such as red-tailed hawk and northern harrier. Raptors, owls, and corvids may perch on telephone poles and in hedgerows along roadsides in the Project area. Farm and residential buildings may provide roosting habitat for some species of passerines and owls. Trees are limited to narrow hedgerows and small clumps at farm residences providing little to no habitat for tree-nesting birds and perches for stopover during migration. As many birds migrate at high altitudes, the airspace above the Project area is potential migration habitat for a variety of species of birds, including passerines, shorebirds, waterbirds, and raptors.

Site Surveys

Hoopeston Wind conducted pre-construction bird surveys in the Project area in 2009 and 2010 sampling breeding, migratory, and winter bird activity (Ecosystem Management 2011). Surveys occurred at 15 point-count locations (9 in 2009 and 6 in 2010) every 2 weeks from mid-March through May and from late-August through mid-November in 2009 and 2010, and once per month from December 2009 through February 2010. [Bird survey reports are provided in Appendix B of this EA.]

Passerines comprised 66% of all birds observed and 77% of all groups observed, raptors comprised 2% of all birds observed and 9% of all groups observed, and shorebirds composed 29% of all birds observed and 6% of all groups observed. Of shorebirds, most were American golden plover (*Pluvialis dominica*) observed in large flocks during spring migration. Other birds (waterfowl, ring-necked pheasant, doves, swifts, and woodpeckers) composed 2% of all birds observed and 6% of all groups observed. Of all species, red-winged blackbirds (*Agelaius phoeniceus*) were detected most frequently (14% of all passerine observations).

The 3 most abundant species in the Project area were American golden plover, European starling (*Sturnus vulgaris*), and brown-headed cowbird (*Molothrus ater*). Together these species made up nearly 60% of observations. Turkey vulture (*Cathartes aura*), red-tailed hawk, and northern harrier were the most abundant raptor species.

Passerines

Passerines using active farmland in greatest numbers included European starling, brown-headed cowbird, red-winged blackbird, horned lark (*Eremophila alpestris*), and common grackle (*Quiscalus quiscala*).

Passerine use was highest during the fall when these species appeared in large flocks (Ecosystem Management 2011).

Shorebirds

Observers documented 1,710 American golden-plovers (*Pluvialis dominica*) in the Project during the avian surveys (Ecosystem Management 2011) during spring migration in 2009 and 2010. Overall shorebird use was greatest in spring, influenced by large flocks of American golden-plovers. Surveyors observed 4 flocks of pectoral sandpipers (*Calidris melanotos*) (81 individuals) during spring surveys, and 54 killdeer (*Charadrius vociferus*) during the spring and fall surveys.

American golden-plovers are a federal watch list species (USFWS 2008). Large numbers of American golden-plovers stage in crop fields in portions of western Indiana and eastern Illinois during spring migration. Freshly tilled agricultural fields appear to be favored for stop-over locations. The Illinois and Indiana Audubon Societies have identified 4 IBAs for American golden-plovers in Illinois and Indiana. Three are located within 55 miles of the Project, and the nearest is roughly 30 miles from the Project in northern Benton County (Project BBCS).

Raptors

Observers documented 127 raptors in 113 separate observations. Across all 3 survey seasons, the most abundant raptors were turkey vulture, red-tailed hawk, northern harrier, and American kestrel (*Falco sparverius*). Raptor use and species composition were similar in spring and fall and decreased substantially during winter (Ecosystem Management 2011).

Eagles

The Project area is approximately 7.25 miles from the nearest known bald eagle nest located on the Middle Fork Vermilion River (Project HCP). No bald eagles were observed during pre-construction surveys conducted at the Project in 2009 and 2010 (Ecosystem Management 2011). Similarly, no eagles were observed or recorded during Project fatality monitoring (Ritzert et al. 2016). The Project area does not contain suitable habitat for nesting eagles, and their occurrence is anticipated to be uncommon. Bald eagles and golden eagles could possibly occur in the Project area as transients during migration or winter. However, based on the aforementioned surveys and mortality monitoring, this is unlikely to be a regular event. The nearest potential nesting and foraging habitats include the North Fork Vermilion River (1.5 miles to the east), Middle Fork Vermilion River (4 miles to the southwest), Windfall Lake (12 miles to the south), and Lake Vermilion (13 miles to the southeast) (Project BBCS).

Listed Species

The Illinois Natural Heritage database lists occurrences of threatened and endangered species by county (IDNR 2015). In Vermilion County, the database lists occurrences of 2 short-eared owls, 1 upland sandpiper (*Bartramia longicauda*), 3 northern harriers, and 2 least bitterns (*Ixobrychus exilis*).

In Illinois, the short-eared owl, state endangered, occurs in wet prairies with tall grasses and reeds (Illinois Raptor Center, not dated). Habitats for least bittern, a state threatened bird, include wetlands surrounding streams, lakes, and other large waterbodies (INHS 2015*d*). These species are not likely to breed in the Project area due to the lack of suitable habitat.

In Illinois, upland sandpipers, state endangered, nest in fields with low to moderate forb cover, low woody cover, and moderate grass cover (such as Kentucky bluegrass (*Poa pratensis*)) interspersed with little bare ground (Kantrud and Higgins 1992, Dechant et al. 1999 as cited by USDA Forest Service 2003*a*). They forage in idle fields and cropland (Graber and Graber 1963 as cited by USDA Forest Service 2003*a*). Spring counts of upland sandpipers have been showing declines in Illinois since 1975 (INHS 2015*e*). This species has not been detected in Vermilion County during spring bird counts since

1994 (INHS 2015*f*). Upland sandpipers were not observed during pre-construction avian surveys (Ecosystem Management 2011).

The northern harrier, state endangered, is considered a common migrant and winter resident in Illinois, and an occasional summer resident (INHS 2015*g*). They breed in pastures, croplands, fallow fields, and undisturbed wetlands or grasslands with thick vegetation (Duebbert and Lokemoen 1977, MacWhirter and Bildstein 1996, Dechant et al. 1999 as cited by USDA Forest Service, 2003*b*).

It is possible that any of the listed species described above could occur in the Project area during migration, but only northern harriers were detected during the site surveys. During pre-construction avian surveys, surveyors documented 18 northern harrier observations, mostly in fall (72%; 13 individuals) (Ecosystem Management 2011). Northern harrier was the third most commonly observed raptor behind turkey vulture and red-tailed hawk. Use was highest in the southeast portion of the Project area in and adjacent to rural grassland vegetation. It is not known if this species breeds in the Project area.

Birds of Conservation Concern
The Fish and Wildlife Conservation Act mandates the Service to "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing" under the ESA." The Service has identified those migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent our highest conservation priorities (USFWS 2008).

The Project is located in the Tallgrass Prairie Bird Conservation Region (BCR). For this BCR, the Service has identified 39 species for which proactive management and conservation actions should be considered. Among these 39 species, bird surveys in the Project area documented the following: cerulean warbler (*Setophaga cerulean*), dickcissel, northern flicker (*Colaptes auratus*), and solitary sandpiper (*Tringa solitaria*). Of these, only the dickcissel is likely to nest in the Project area in suitable habitats.

3.3.3 Bat Resources

3.3.3.1 Scope of Analysis

This section first describes bat resources in general then discusses existing conditions for bats within the Project area. For the purpose of this NEPA analysis, federally listed and unlisted bats (those species not listed as threatened or endangered under the ESA) are addressed together in this section. In Section 3.3.3.3, we provide additional information specific to Indiana bats and northern long-eared bats pertinent to the analysis of covered species. Analysis of bat resources is based on the following:

- Information request to IDNR and the Service for any information on known roost sites or hibernacula in the Project area (as reported in Ecosystem Management 2011; Appendix C)
- Project HCP
- Project BBCS (Appendix A)
- Results of 2009, 2010, and 2014 pre-construction acoustic bat surveys conducted in the Project area (Appendix C)
- Results of rare bat habitat assessment (Appendix C)
- Results of Indiana bat and northern long-eared bat telemetry study (Appendix C)

3.3.3.2 Distribution, Habitat Use, and Status

Thirteen bat species occur in Illinois, 12 of which have the potential to occur in Vermilion County (Table 3-1) based on their normal ranges (England et al. 2001). Of these 12 species, 2 are covered species in the

Project HCP. The Indiana bat is federally and state-listed as endangered, and the northern long-eared bat is federally and state-listed as threatened. Both the Service and the State of Illinois also are collecting information to review the status of the little brown (*Myotis lucifugus*) bat to determine if threats to the species may be increasing its risk of extinction. Listing considerations and status reviews for both the northern long-eared bat and little brown bat have largely focused on impacts from white-nose syndrome (WNS), a fungal disease affecting cave-hibernating bats (discussed in greater detail in Section 3.3.3.3).

Reliable population data are available for the Indiana bat rangewide (discussed in Section 3.3.3.3). Cave counts for Indiana bats have included counts of northern long-eared bats and other species of bats to some degree. However, northern long-eared bats are difficult to detect in hibernacula, move between hibernacula during the winter, and many hibernacula are likely not known. Hence, hibernacula counts cannot be used to produce a rangewide population estimate for the species (USFWS 2016*b*; population estimates are discussed in Section 3.3.3.3.). Additionally, population data for other species of bats are not known.

Table 3-1. Status and winter habitat of bat species with potential to occur in Vermilion County.

Common Name	*Scientific Name*	Status	Typical Winter Habitat[1]
Indiana bat	*Myotis sodalis*	Federal and state endangered	Hibernates in caves and mines
Northern long-eared bat	*Myotis septentrionalis*	Federal and state threatened	Hibernates in caves and mines
Little brown bat	*Myotis lucifugus*	--	Hibernates in caves and mines
Silver-haired bat	*Lasionycteris noctivagans*	--	Tree-roosting, long-distance migrant
Tri-colored bat	*Perimyotis subflavus*	--	Hibernates in caves and mines
Big brown bat	*Eptesicus fuscus*	--	Hibernates in caves, mines, structures
Eastern red bat	*Lasiurus borealis*	--	Tree-roosting, long-distance migrant
Hoary bat	*Lasiurus cinereus*	--	Tree-roosting, long-distance migrant
Evening bat	*Nycticeius humeralis*	--	Probable long-distance migrant
Southeastern bat	*Myotis austroriparius*	State endangered	Hibernates in caves in north, more exposed sites in south
Gray bat	*Myotis grisescens*	Federal and state endangered	Hibernates in caves and mines
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	State endangered	Hibernates in caves, mines, cisterns, and wells

[1] Source: England et al. (2001).

Roosting and Foraging

When not hibernating, bats in the region roost in a variety of habitats including tree crevices or cavities, underneath loose tree bark, and sometimes in buildings or other structures. Reproductive females of *Myotis* species, tri-colored bat, and evening bat typically form maternity colonies of up to 75 or more bats in suitable roosts, occasionally switching among various roosts. Males and non-reproductive females of these species are typically solitary during the spring and summer, but also use tree and/or buildings or other suitable structures for roosting habitat (England et al. 2001). These bats, particularly big brown bats and evening bats, may occasionally forage over cropland within the Project area, but most species in the region are more likely to use forested and open water habitats (BatCon 2015).

Regional information is limited on seasonal roosting habitat and distribution of long-distance migratory species including the hoary bat, silver-haired bat, and eastern red bat. Mortality patterns at existing wind farms and a growing body of long-term acoustic survey records indicate that long-distance migratory species move through the region between mid-August and mid-September, likely roosting in trees or foliage during the day.

Little is known regarding bat use of agricultural areas in the Midwest. Bat species likely to occur in the Project area forage in a variety of habitats and include species adapted to foraging in cluttered and open habitats. Foraging habitat preference varies among species, likely driven by distribution and abundance of suitable insect prey and morphology of each bat species.

Hibernation and Seasonal Migration

Bats listed in Table 3-1 include both short-distance migrants that hibernate colonially within the region in winter (typically in caves or mines) and long-distance migrants that migrate out of the region in winter and are thought to hibernate primarily in trees. Bats of all species are typically absent from the landscape in the region of the Project area between November and March and either emerge from hibernacula or migrate to the region in spring (April-May).

Little is known about the migratory behavior of bats. Cave-hibernating bats disperse up to several hundred miles from hibernacula to summer habitats, with females often dispersing farther from hibernacula than males (Fleming and Eby 2003). Seasonal timing and species composition of bat mortality at wind farms indicate bats are at increased risk of collision during migration, particularly during fall migration. This increased risk of mortality may be related to an attraction to tall structures, mating or courtship behavior, increased flight height, or failure to detect turbines during migratory flight (Kunz et al. 2007*a, b;* Cryan 2008).

3.3.3.3 Rare, Threatened, and Endangered Bats

Indiana Bat

Section 5.1 of the Project HCP provides an in-depth account of the Indiana bat. Below we provide a brief description of Indiana bat status, biology, behavior, and habitat requirements relevant to this EA and its analysis. For a more detailed description of the species, please refer to the Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (Recovery Plan; USFWS 2007).

Status

The Service originally listed the Indiana bat as in danger of extinction on March 11, 1967, under the Endangered Species Preservation Act of 1966 (USFWS 1967; 32 FR 4001). The species remains listed as endangered under the ESA of 1973, as amended. The estimated rangewide Indiana bat population in 2017 was 530,705, down 3.5% from 2015 (550,224) (USFWS 2017*a*). As of 2017, the Service had records of extant winter populations >1 in 15 states (USFWS 2017*a*).

The Indiana bat is listed as state endangered in and protected under Illinois' Endangered Species Protection Act-520 ILCS 10/1, and regulatory authority is the responsibility of IDNR.

Maternity colonies are known to occur in Vermilion County and summer records are known from adjacent Ford County (USFWS 2007). In July 2010, an Indiana bat maternity colony was found near the Middle Fork of the Vermilion River in Ford and Champaign counties (K. Shank, IDNR, personal communication), 10 miles from the Project area. Indiana bats are known to occur in the Kickapoo Recreation Area, 30 miles south of Hoopeston in Oakwood, Illinois, and in Woodyard State Natural Area, 40 miles south of Hoopeston in Georgetown, Illinois (VRWCP 2011).

Illinois has 22 known hibernacula, and of these, 16 sites have had at least 1 bat since 1995 (USFWS 2007). No known hibernacula occur in the Project area or Vermilion County (USFWS 2007). Blackball Mine located in LaSalle County is the closest known hibernaculum to the Project (USFWS 2007), approximately 130 miles to the northwest of the site. This hibernaculum is considered a Priority 2 site containing a population of 1,804 Indiana bats, and is the only designated critical habitat in Illinois.

The Recovery Plan defines 4 Recovery Units based on "evidence of population discreteness and genetic differentiation, differences in population trends, and broad-level differences in macrohabitats and land use." The Project area is within the Ozark-Central Recovery Unit (OCRU), which includes the Indiana bat's range in Illinois, Missouri, Arkansas, and Oklahoma (USFWS 2007). The overall Indiana bat population in Illinois was approximately 53,940 in 2015 (Table 3-2; USFWS 2017*a*). This represented 20% of the 2015 OCRU population (271,254) and 10.2% of the overall 2015 population (550,224) (USFWS 2017*a*). The Indiana bat population in the OCRU has been relatively stable from 2007 through 2015 (Table 3-2). WNS was first documented in the OCRU in Missouri in 2010 (MDC 2015). It was confirmed in Illinois in LaSalle, Monroe, Hardin, and Pope counties in February 2013 and spread further (Union, Jackson, Johnson, Adams, Pike, Carrol, Alexander and Saline counties) as of winter 2015 , and then Jo Daviess and Madison counties in winter 2016 (USFWS 2017*b*).

Table 3-2. Indiana bat population estimates for the Ozark-Central Recovery Unit (USFWS 2017*a*).

State	2007	2009	2011	2013	2015	2017	% change from 2015	% of 2017 total
Illinois	53,824	53,351	57,212	58,840	53,940	52,354	-2.9	9.9
Missouri[1]	183,304	211,107	212,862	214,255	215,911	217,884	0.9	41.1
Arkansas	1,821	1,480	1,260	856	1,398	1,722	23.2	0.3
Oklahoma	0	0	13	5	5	5	0.0	0.0
Total	238,949	265,938	271,293	273,956	271,254	271,965	0.3	51.2

[1]A previously unknown Indiana bat hibernaculum was discovered in Missouri in 2012, which contained 123,000 bats when surveyed in January 2013, which has been added to each previous survey year due to first-hand accounts of large clusters/numbers of hibernating bats for the past several decades prior to discovery by bat biologists.

Threats

Threats to Indiana bats have included modification to hibernacula that change the airflow and alter the microclimate, human disturbance and vandalism causing direct mortality during hibernation, natural events during winter affecting large numbers of individuals, disease, and loss and degradation of summer habitat (USFWS 2007). WNS is a new, potentially devastating threat to Indiana bats throughout their range. WNS is a fungal infection first identified in eastern New York during the winter of 2006–2007 and is named for the visible presence of a white fungus around the muzzle, ears, and wing membranes of some infected bats. A previously unreported species of cold-loving fungus (*Pseudogymnoascus destructans*, formerly *Geomyces destructans*) is the primary pathogen associated with WNS (Warnecke et al. 2012). It is an invasive fungus with probable origins in Europe (Leopardi et al. 2015) and thrives in conditions characteristic of bat hibernacula.

WNS causes bats to arouse more frequently during hibernation, with reductions in the length of bouts of torpor associated with increased mortality rates (Reeder et al. 2012). In 2012, the Service estimated the fungus had killed 5.7–6.7 million bats since its discovery in 2006 (USFWS 2012*c*). WNS affects most species of bats that hibernate in the northeast, with the little brown bat, northern long-eared bat, and Indiana bat among the most impacted. Based on winter cave counts, the Appalachian Mountain Recovery Unit declined by 46% between 2011 and 2013 (USFWS 2013*a*).

Hibernation and Seasonal Migration

Indiana bat maternity colonies begin to disband in the first 2 weeks of August, with most bats leaving their summer ranges by mid-September. Indiana bats are highly mobile during fall, eventually congregating near hibernacula between August and October and swarming on a nightly basis for up to several weeks. Although swarming occurs near cave entrances, bats roost in trees during swarming rather than in the caves and travel long distances from hibernacula and occasionally moving between hibernacula (USFWS 2007). Bats mate near the end of the swarming period, with females entering hibernation soon after mating and males remaining active until later in fall.

Indiana bats typically begin hibernation between mid-October and mid-November, concentrating in a limited number of caves or abandoned mines with suitable characteristics. Spring emergence varies with latitude and weather conditions. Studies in Indiana and Kentucky document peak emergence of females in mid-April and males in early May (Cope and Humphrey 1977). After emerging from hibernacula in spring, Indiana bats travel up to several hundred miles to their summer range, with females typically traveling greater distances than males (USFWS 2007). Behavior and habitat needs of Indiana bats during spring migration are poorly understood, although they appear to move quickly to summer ranges.

Summer Roosting Habitat Requirements and Foraging Behavior

Indiana bats roost primarily in trees during summer, usually under exfoliating bark and occasionally using narrow crevices or cracks in trees located in semi-open areas of forest with greater solar exposure (USFWS 2007). Indiana bats switch among primary and secondary roosts throughout the summer, with maternity colonies focusing use on a small number of primary roosts but using up to 10–20 total trees throughout the summer (USFWS 2007).

Indiana bats are nocturnal insectivores, feeding exclusively on flying insects. They typically forage from 6–100 feet above the ground and hunt primarily around, not within, the canopy of trees (USFWS 2007). Indiana bats preferentially forage in wooded areas, with forest type varying among studies, including closed to semi-open forests and forest edges (USFWS 2007). Foraging studies in Illinois indicate floodplain forest is the most preferred habitat, followed by ponds, old fields, row crops, upland woods, and pastures (USFWS 2007).

Telemetry studies have documented nightly foraging distances for female Indiana bats ranging from 0.3–5.8 miles from nightly roosts, with mean distances from 1.6–3.0 miles (Murray and Kurta 2004, Sparks et al. 2005, USFWS 2007). The size of foraging areas likely depends on extent of suitable habitat, interspecific competition, and prey availability. Rather than crossing large areas of unsuitable habitat, Indiana bats tend to follow corridors of suitable habitat, even if it means flying a greater distance (USFWS 2007).

Northern Long-eared Bat

The HCP provides an in-depth account of the northern long-eared bat (see Section 5.2). Below we provide a brief description of northern long-eared bat biology, behavior, and habitat requirements relevant to this EA and its analysis. For a more detailed description of the species, please refer to the Service's final rule for listing the northern long-eared bat (USFWS 2015*d*).

Status

The Service listed the northern long-eared bat as threatened and established an interim 4(d) rule on April 2, 2015 (USFWS 2015*d*). The Service found listing is warranted due to the recent severe and ongoing decline of the species due to WNS. The finding lists other threats to northern long-eared bats, but recognizes that WNS is the primary threat to the species continued existence (USFWS 2015*d*). The winter surveys have observed declines in northern long-eared bats in hibernacula in Illinois (Davis 2014 as cited by USFWS 2015*d*). (See Indiana bat section above for a brief description of WNS and its associated fungus.)

On January 13, 2016, USFWS published a final 4(d) rule that removes or exempts prohibitions for incidental take of northern long-eared bats (USFWS 2016*a*). In areas of the U.S. not affected by WNS, the 4(d) rule removes prohibitions of take. In areas impacted by WNS, the 4(d) rule prohibits incidental take that occurs in hibernacula or that results from tree removal activities near maternity roost trees or hibernacula However, the 4(d) rule allows incidental take that results from operating wind turbines and permanent conversion of forested lands to other uses (e.g., creation or expansion of rights-of-way and urban development).

The northern long-eared bat is a relatively wide-ranging bat, but it appears to be patchily distributed and found in low numbers in both roosts and hibernacula (Griffin 1940, Barbour and Davis 1969, Caire et al. 1979, Amelon and Burhans 2006, ASRD and ACA 2009). The Service categorizes the U.S. range of the species in 4 parts: eastern, midwest, southern, and western ranges and estimates a rangewide population of 6.5 million adults (USFWS 2016*a*). In the Biological Opinion for the 4(d) rule (USFWS 2016*b*), the USFWS estimates summer adult populations for each state. These estimates are based on total forested acres in each state and occupancy rates using the proportion of sites occupied by northern long eared in the total number of sites sampled (typically using mist-net surveys). The Service estimates there are 213,720 northern long-eared bats in Illinois and roughly 2.8 million in the Midwest region.

Hibernation and Seasonal Migration

In Illinois, northern long-eared bats hibernate from November 1 through March 31 (USFWS 2014). Hibernation periods farther north may begin earlier and end later (Stones and Fritz 1969 as cited by Fitch and Shump 1979). Northern long-eared bats share hibernacula with other bat species (Fitch and Shump 1979, Whitaker and Mumford 2009 as cited USFWS 2015*d*), but Barbour and Davis (1969) did not find any in concentrations over 100 individuals in a hibernaculum. Individuals may also rouse and switch hibernacula throughout the winter, which makes it difficult to accurately estimate winter population numbers (Griffin 1940, Whitaker and Rissler 1992, Caceres and Barclay 2000). Little is known about the migration patterns of northern long-eared bats, particularly how and where they disperse across the landscape during migration; however they are known to occur in Vermilion County and the Project area is within their migratory range. There are 21 known hibernacula in Illinois with one or more winter records; the majority of these are in the southern portion of the state (USFWS 2015*d*).

Summer Roosting Habitat Requirements and Foraging Behavior

In Illinois, the summer breeding season for northern long-eared bats is April 1 through September 30 (USFWS 2014). During the summer, northern long-eared bats inhabit forests and roost singly or in colonies in the cracks, crevices, and bark of both live and dead trees (Lacki and Schwierjohann 2001).

They have been found roosting in structures such as buildings, barns, sheds, and cabins. Foster and Kurta (1999) have indicated that northern long-eared bats do not depend on any particular species of tree for roosting but tree characteristics, such as structure and decay, are important. Northern long-eared bats have been found roosting below the canopy in forests with a variety of canopy cover percentages, but Perry and Thill (2007) found relatively open forests in Arkansas to be important for female roosts as compared to male roosts.

The northern long-eared bat forages on a variety of insects. The most common are moths, beetles, and spiders (Brack and Whitaker 2001, Feldhamer et al. 2009). Northern long-eared bats forage and commute primarily in forested interiors (Jung et al. 1999, Owen et al. 2003, Carter and Feldhamer 2005, Broders et al. 2006). Foraging techniques include hawking (catching insects in flight) and gleaning (catching insects from vegetation and water surfaces) (Ratcliffe and Dawson 2003, Feldhamer et al. 2009). Northern long-eared bats show preference for forested hillsides and ridges, as opposed to riparian areas (LaVal et al. 1977, Brack and Whitaker 2001). This preference corresponds with the suggestion expressed in Caceres and Pybus (1997) that mature forests are important foraging habitat for northern long-eared bats. Recent capture efforts have found northern long-eared bats in young stands and disturbed forests (Crampton and Barclay 1998, Foster and Kurta 1999, Cryan et al. 2001, Menzel et al. 2002, Henderson and Broders 2008, Henderson et al. 2008, ASRD and ACA 2009).

3.3.3.4 Existing Condition in the Project Area

Site Surveys

For the Project, pre-construction surveys included the following:

- A desktop habitat assessment and field visit to identify potentially suitable habitat for Indiana bat and northern long-eared bat (Hale et al. 2014)
- Active acoustic bat surveys in spring and fall 2009 and spring and fall 2010 (Ecosystem Management 2011)
- Passive acoustic bat surveys in 2009, 2010, and 2014 (Ecosystem Management 2011, Stantec 2015*a*)
- Rare bat telemetry study in 2014 (Boyles and McGuire 2014)

Below we summarize relevant results from the on-site surveys, and the Project HCP provides a brief synopsis in Section 3.10. The full survey reports are included in Appendix C.

Habitat Assessment

In 2014, Hale et al. conducted a habitat assessment for Indiana bat and northern long-eared bat. Most of the Project area consists of active, tilled agriculture with sparse instances of narrow bands of trees and shrubs (Figure 3-2), often along creeks and ditches (Figure 3-1). Fifteen forested areas within the Project boundary are considered suitable habitat for both Indiana bat and northern long-eared bat. These areas are >1,000 feet from turbines. These consisted of 9 shelterbelts (i.e., narrow bands of trees and shrubs that protect fields from exposure to wind to lessen erosion), 2 areas of isolated roost trees, 3 riparian forested areas, and a 6-acre forest block (Hale et al. 2014).

Active Acoustic Surveys

Ecosystem Management (2011) conducted active acoustic surveys on 2 nights during spring 2009 and 2 nights during spring 2010 and on 3 nights during fall 2009 and 2 nights during fall 2010. Each survey lasted for 1 hour. Surveyors walked slowly with an Anabat SD1 bat detector in hand attempting to record bat calls and observe bats at the western end of the Project (south of the intersection of N 770 East Road and E 3700 North Road). No bats were detected in either spring survey period. In fall 2009, bats were detected on all 3 survey nights (September 21, 22, and 28). Bat detectors recorded 10 big brown bat calls, 3 red bat calls, 1 *Myotis* species call, and 8 calls that could not be identified to species or species' group. In fall 2010, bats were detected on both survey nights (August 31 and September 1). Detectors recorded 17 big brown bat calls, and 30 calls that could not be identified to species or species' group. At the time of survey completion, active acoustic data were not available from any other Illinois wind projects for comparison (Ecosystem Management 2011).

Passive Acoustic Surveys

Ecosystem Management (2011) conducted passive acoustic surveys at 3 sites in 2009 and at 6 sites in 2010. Surveys occurred for 2 weeks in spring 2009 (April 16 to May 3) and fall 2009 (September 14 to September 28) and spring 2010 (April 12 to May 3) and fall 2010 (August 31 to September 29). Survey sites in 2010 were spread across the Project area adjacent to small woodlots, near tree rows, and hedgerows, and in one case, near water. The majority of calls in all 4 seasons could not be identified to species because they contained too few pulses or the call characteristics overlapped more than 2 species (Ecosystem Management 2011). Species-specific results are presented in Table 3-3 below.

Table 3-3. Species-specific results of passive acoustic monitoring from 2009–2010 pre-construction surveys conducted at the Hoopeston Wind Project (EcoSystem Management 2011).

Year	Season	Survey dates	Bat calls recorded	Most abundant species (relative call frequency)[1]	Relative call frequency of *Myotis* bats
2009	Spring	Apr 16– May 3	110	red bat (32%)	0.02
2009	Fall	Sep 14 – Sep 28	408	big brown bat (14%)	0.03
2010	Spring	Apr 12 – May 3	1,003	big brown bat (0.9%)	0.00
2010	Fall	Aug 31 – Sep 29	1,690	big brown bat (11%)	0.01

[1] For calls identified to species.

In 2014, Stantec conducted passive acoustic sampling at 2 locations during the fall migration period (July 31 to October 31) (Stantec 2015*a*) while the Project was under construction. Two detectors were placed on the Project meteorological tower in an open agricultural field at heights of 2 meters (6.6 feet) and 50 meters (164 feet) above ground level (agl). A third detector was deployed in the eastern portion of the Project area along N 1280 East Road within a narrow band of trees at a height of 2 meters agl.

Several *Myotis* calls were recorded during the acoustic surveys, but positive identification of species was not possible for many calls due to call quality and overlap in call characteristics among little brown bat, northern long-eared bat, and Indiana bat. Detectors recorded 1,189 bat passes, of which 1,020 were classifiable calls. Approximately 86% of the 1,020 classifiable calls were identifiable to species. Calls of 8 species were recorded: big brown bat, red bat, hoary bat, silver-haired bat, tri-colored bat, evening bat, little brown bat, and northern long-eared bat. Table 3-4 shows results by detector. At all 3 detectors, bat activity peaked in September, and silver-haired bat was the most commonly recorded species. No *Myotis* calls were recorded at either MET tower detector. Five *Myotis* calls were recorded at the tree-based detector, including 1 northern long-eared bat call on October 20 (Stantec 2015*a*).

Table 3-4. Results by detector of passive acoustic monitoring during 2014 surveys conducted at the Hoopeston Wind Project (Stantec 2015*a*).

Detector	Proportion of total calls recorded (number of calls)	Bat activity rate (passes/detector night)	Proportion of calls that were silver-haired bat	Number Myotis calls
High MET tower	16% (194)	3.1	86%	0
Low Met tower	35% (419)	6.8	84%	0
Tree	48% (576)	9.6	44%	5

Telemetry Study

Boyles and McGuire (2014) conducted a telemetry study of Indiana bats and northern long-eared bats captured at the Middle Fork Forest Preserve, approximately 6 miles west of the Project. The surveyors installed a receiving antenna array and datalogger at the Project site to detect movement of the radio-tagged bats. Additional receiving arrays with dataloggers were installed at 6 other locations in the region. The team captured 26 bats representing 5 species from August 8–24, 2014. They outfitted 8 bats (3 northern long-eared bats and 5 Indiana bats) with transmitters. The datalogger within the Project area did not detect any of the bats with transmitters.

3.4 SOCIOECONOMIC ENVIRONMENT

In this section, we describe the socio-economic characteristics of Vermilion County. The Project affects economic conditions in the region largely through state and local taxes and lease and royalty payments to participating landowners.

3.4.1 Economic Resources

Hoopeston and Rossville are the nearest communities to the Project. As of the 2010 census, Hoopeston's population was 5,351, and Rossville's population was 1,331. Major economic centers are located in Danville (~18 miles south) and Champaign (~50 miles southwest). Income data for the state and Vermilion County are presented in Table 3-5 and are based on 2010 U.S. Census Bureau data.

Table 3-5. **Income statistics in the region of the Hoopeston Wind Project based on 2010 census (U.S Census Bureau 2015)**

	Population	Median Household Income	Persons Below Poverty Level (%)
State of Illinois	12,830,632	$56,797	14.1
Vermilion County	81,625	$41,400	19.6
City of Hoopeston	5,351	$38,261	18.3

Hoopeston and Vermilion County are part of the Danville, Illinois, Metropolitan Statistical Area., which reported a 6.4% unemployment rate in September 2015 (USBLS 2015). Illinois Department of

Employment Security reported 6.7% unemployment rate for Vermilion County in September 2014 (IDES 2015).

Hoopeston Wind employs nine full-time, permanent workers to operate and maintain the Project. Hoopeston Wind also has contracted part-time, temporary workers to conduct post-construction carcass monitoring from April 1 through October 15.

3.4.2 Environmental Justice

Executive Order 12898 requires federal agencies to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

There are minority and low-income populations in Hoopeston, Rossville, and Vermilion County. However, Project operations and mitigation measures for listed bats will not have any disproportionate adverse environmental impacts to minority and low income populations in the affected environment requiring additional consideration under environmental justice requirements. Specifically, minority and low income groups or individuals are not expected be impacted at a rate that appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group. Therefore, further consideration of the environmental justice policy under NEPA is not required. If environmental impacts occur to minority or low-income individuals and rise to the level of significance under NEPA, it is highly improbable that there will be a disproportionate impact. Hence the impacts, positive or negative, that will occur under the proposed action or any alternative will be neither disproportionately gained nor borne by minority or low income populations.

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1 OVERVIEW OF THE EFFECTS ANALYSIS

This chapter describes the environmental effects of each of the three alternatives retained for detailed analysis. The chapter is organized by resource and corresponds to the organization of Chapter 3. Each alternative includes the operation of a wind project, implementation of the BBCS, and post-construction monitoring. The three alternatives differ with respect to operational adjustments and the extent of mitigation implemented to offset the impact of taking Indiana bats and northern long-eared bats.

In each alternative, all 49 turbines would be feathered at night until wind speeds reach the specified cut-in speed. Only Alternative 2 would use a temperature criterion.

Our analysis in this EA is commensurate with the estimated impacts associated with Project operations and focuses primarily on avian and bat resources. We estimate that effects on noise, vegetation, non-volant wildlife, and socioeconomics (economics) will be minor. Hence, we provide limited analyses for these resources.

In each resource section, we first address direct and indirect effects common to all alternatives and then for each alternative. Each resource section concludes with a summary of effects each alternative will have on that resource. At the end of all resource sections, we address cumulative effects. As per the CEQ guidelines (CEQ 1997), resources that will be unaffected by the proposed action or other alternatives, experience beneficial effects, or are subject to temporary effects, were excluded from our cumulative effects analysis. Using this screening process, our analysis of cumulative effects is limited to bird and bat resources (found in Sections 4.3.2 and 4.3.3).

4.2 PHYSICAL ENVIRONMENT

4.2.1 Air Quality and Climate

4.2.1.1 Impact Criteria

The Clean Air Act of 1970 (CAA), and the CAA Amendments of 1990 established National Ambient Air Quality Standards (NAAQS) for selected pollutants. The NAAQS established maximum levels of acceptable background pollution with a margin of safety to protect public health and welfare. NAAQS compliance in Illinois is monitored by the IEPA.

CEQ guidance requires federal agencies consider GHG emissions and climate change when evaluating proposed actions.

4.2.1.2 Direct and Indirect Effects

Project Operations and Maintenance

Per the CAA and the Amendments of 1990, USEPA has established New Source Performance Standards (NSPS) to regulate air pollution emissions from new stationary sources. These standards apply to various facilities, but because wind turbines generate electricity without releasing air pollutants, NSPS do not apply to the Project.

The Acid Rain Program, established by CAA Amendments of 1990 to lower sulfur dioxide and nitrogen oxides emissions, does not apply to the Project because wind turbines generate electricity without releasing air pollutants. Likewise, the Prevention of Significant Deterioration (PSD) rules do not apply because the Project will not add a new source or modify an existing source of pollutants in an attainment area.

On August 1, 2016, the CEQ issued their final guidance for federal agencies to implement when considering the effects of regarding GHG emissions and climate when evaluating federal actions under NEPA. The guidance recommends the acting agency quantify direct and indirect GHG emissions using available data and GHG quantification tools suitable for the proposed action and comparing these data among alternatives.

Regardless of the alternative implemented, Project operations will not release pollutants into the atmosphere or result in adverse effects to air quality. Project operations require a small amount of vehicular traffic resulting in the release of carbon dioxide emissions and particulates. Project maintenance and post-construction monitoring will necessitate some increases in vehicular traffic and construction equipment in and around the Project, but this added impact to air quality is expected to be inconsequential and common among the alternatives. These emissions are not estimated to have a measurable effect on local or regional air quality or contribute greatly to the amount of GHG emissions. Project operations will not generate any new sources of air pollutants.

Energy production would be highest under Alternative 3 (3.0 m/s cut-in speed), followed by Alternative 2 (a mix of 5.0 m/s and 3.0 m/s cut-in speeds) then Alternative 1: No-Action Alternative (6.9 m/s cut-in speed). Under any of the three alternatives under consideration, power delivered to the grid from the Project will not cumulatively add to pollutant or GHG emissions produced at existing conventional power plants.

Under implementation of Alternative 3, the Applicant estimates that the electricity generated by the Project provides emissions-free power for the equivalent of 32,000 homes while displacing fossil fuel generation. This displacement reduces GHG emissions by a level equivalent to taking approximately 52,000 passenger cars off the road and avoids the release of approximately 245,000 metric tons of carbon dioxide per year. Implementation of the No-Action Alternative or Alternative 2 will result in a reduction of these air quality benefits due to the reduced output of electricity from the Project and the lost displacement of CO_2 (Table 2-1). Roughly 50% percent of the net electricity generated in Illinois is produced by projects that emit CO_2 (USEIA 2016).

Under any of the three alternatives, the Project will not contribute significantly to GHG emissions that could contribute to problems associated with climate change.

Post-construction Monitoring

All three alternatives include post-construction fatality monitoring to be implemented as described in the HCP and BBCS. Post-construction monitoring will result in a small amount of vehicle emissions associated with surveyors commuting to search turbines. These emissions will have minor to negligible impacts to local air quality and will not vary significantly among alternatives.

Project Decommissioning

Implementation of any of the three alternatives will include decommissioning the Project at the end of its operational life or if the Project is non-operational for an extended period with no expectation of returning to operation. Decommissioning activities will involve large construction equipment and other vehicles that will have temporary and localized impacts to air quality. Impacts will occur as a result of emissions from engine exhaust (criteria pollutants and GHGs) and fugitive dust generation during earth-moving and travel on unpaved roads. Dust may annoy existing residents and travelers and be deposited on surfaces at certain locations in public areas or near residences. Fugitive dust associated with vehicle travel on gravel roads and with agricultural practices is a normal occurrence in and around the Project area. Residents are likely accustomed to coping with dust. Decommissioning may increase the amount of fugitive dust in some areas within Project area, but this would be temporary and last only during the decommissioning process.

No significant adverse effects to air quality would occur as a result of Project decommissioning under any of the three alternatives.

Mitigation

The No-Action Alternative does not include mitigation projects for addressing take of covered species because take of Indiana bats and northern long-eared bats would be avoided.

Implementation of either of the action alternatives would include habitat mitigation for both the Indiana bat and northern-long eared bat. For summer habitat mitigation, the areal extent of mitigation under Alternative 2 would be less (117 acres) than that provided under Alternative 3 (165 acres) given the lower amount of authorized take to mitigate. Summer habitat restoration may contribute toward improvements in air quality, as increasing the amount of tree cover in an area could help reduce harmful gasses and particulate matter in the air. Effects to air quality associated with implementation of summer habitat mitigation would be lower for Alternative 2 compared to Alternative 3. In the long term, a reforestation project will benefit air quality, but the amount is immeasurable and likely to be negligible. The Project, under any alternative implemented would have no negative effects to the air quality.

4.2.1.3 Summary of Effects to Air Quality and Climate

Under any of the alternatives, Project operations, maintenance, and decommissioning would have minor effects on air quality. There would not be significant differences among alternatives with regard to any minor negative effects to air quality. Project operations would not produce GHG emissions or contribute to the problems generally accepted to contribute to climate change issues. Project operations would have beneficial effects to air quality and climate by offsetting carbon emissions, by which Alternative 3 provides the highest benefit (Table 2-1). Under either action alternative, mitigation that includes restoring forest habitat could potentially improve air quality at the local scale.

The Project is expected to have negligible negative effects to air quality; therefore, no specific mitigation measures for air quality and climate will be implemented under any of the three alternatives.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 General Wildlife

This section analyzes the effects of the considered alternatives on terrestrial, non-volant wildlife (refer to Section 4.3.3 and Section 4.3.4 for the impacts analysis on birds and bats, respectively). This analysis uses information on wildlife for the region and within the Project area. Habitat for aquatic species in the Project area is limited, and Project operations are not expected to affect aquatic wildlife. Hence, our analysis does not address aquatic wildlife.

4.3.1.1 Impact Criteria

Major impacts to wildlife and aquatic resources are those that substantially affect a species' population (locally, regionally, or rangewide) or reduce its habitat quality or quantity. Impacts to species can be both direct and indirect. Examples of direct effects include disturbance, injury, mortality, and habitat alteration. Examples of indirect effects include habitat loss or degradation over time or effects to resources used by wildlife in different life stages (e.g., alterations to surface water or alterations to plant composition). Another indirect effect may be the creation of habitat such as edges and openings that favor a different mix of species and in some cases, increase predation pressure, thereby causing displacement or avoidance.

4.3.1.2 Direct and Indirect Effects

Operation of the Project under any of the three alternatives is expected to have similar effects to general wildlife.

Project Operations and Maintenance

There are limited data available addressing impacts to mammals, reptiles, and amphibians associated with habitat loss due to displacement from operating wind project developments in the U.S.; the majority of studies have focused on bird and bat collision mortality. Potential effects, to mammals in particular, likely depend on the species, geographic location, project size, and the spatial and temporal scales at which these effects are studied (Helldin et al. 2012).

Common species such as white-tailed deer, raccoon, and skunk become habituated to human activity and habitat modification. While habituation may not be immediate, species likely to occur in the Project area would adapt quickly to the presence of man-made features in their habitat, evidenced by the abundance of these species in suburban and working farm settings. White-tailed deer, coyote, red fox, and other terrestrial mammals have been observed at recently constructed wind projects in the eastern U.S. (Stantec, unpublished data). Marked displacement of common mammals from a wind project has not been reported. We can expect that the Project would not affect the use of agricultural fields for wildlife that use this habitat type, including commonly occurring common mammals as well as common reptiles and insects.

The effect of shadow flicker, electrocution, or stray voltage on terrestrial animals is unknown. During times when ice can form on turbine blades, ice sheets could be thrown from tower blades. In rare events, turbine towers could collapse or fires could occur. However, the likelihood of these phenomena killing a mobile terrestrial animal is very low.

Project operations may attract terrestrial wildlife typically drawn to investigate carcasses (from turbine collisions and persistence and searcher trials) while searching for food. If consistent carcass presence is a regular event, carcasses may become a regular food source for some mammal species, including coyote, raccoon, and red fox.

The agricultural habitat in the Project area is common and the terrestrial species known to inhabit agriculture areas are common; therefore, habitat loss, avoidance, or displacement effects to terrestrial wildlife populations, should they occur, are expected to be minor. Consequently, population level effects for any species of terrestrial wildlife from operation of the Project under any of the three alternatives are not expected.

Project maintenance activities primarily include work inside the turbine tower and nacelle but may also include periodic road maintenance (e.g., snow plowing, grading) and possibly herbicide application.

While travelling within the Project area maintenance vehicles may collide with terrestrial wildlife causing injury or death.

Disturbance from noise, vibration, and increased human activity and traffic associated with maintenance activities would occur infrequently and for relatively short durations. Common wildlife known to occur in the Project area are likely to habituate to noise, vibration, and human intrusion, which will not be significantly different from the agricultural activity that already occurs within and in the vicinity of the Project area. Tools used during maintenance activities and turbine parts such as bolts have the potential to fall from the turbines during maintenance. However, the likelihood of such materials striking and killing a terrestrial animal is low.

Post-construction Monitoring

All three alternatives include post-construction monitoring to be implemented as described in the HCP. Effects to terrestrial wildlife resulting from post-construction monitoring may include disturbance or mortality due to increased vehicle traffic and human presence. Furthermore, any vehicle-induced fatalities may attract scavengers.

As described in Section 7.3.4 of the Project HCP, post-construction monitoring will include searcher efficiency and carcass persistence trials, in which carcasses are placed in the Project area to assess searcher success and carcass removal by scavengers. Cleared turbine pads will make fatalities easily detectable to scavengers, such as coyote, raccoon, and red fox, during these trials. Smallwood (2013) estimates that on average 74% of bird carcasses and 70% of bat carcasses are taken by scavengers within 30 days at wind projects in North America. Scavenging wildlife may be susceptible to vehicle collisions while moving between turbine plots to locate carcasses.

Project Decommissioning

Impacts on wildlife from decommissioning activities would be disturbance or potential displacement via vehicular traffic, construction noise, vibration, and increased human and equipment presence. However, decommission impacts would be localized and for a relatively short duration. Species in the Project area are likely to become habituated to noise, vibration, and activities associated with the Project by the time decommissioning activities are conducted.

Project decommissioning would minimize the long-term impacts to terrestrial wildlife (as opposed to permanent presence and operation) by removing turbines from the Project area and restoring the area to the pre-existing agricultural condition. Decommissioning would increase habitat for species that use agricultural landscapes.

Mitigation

Project operations under any considered alternative are not expected to result in impacts to general wildlife, and no mitigation specific to general wildlife is proposed. Mitigation for covered species under Alternative 3 is described in Section 2.2.3.2 and would include summer habitat protection or restoration to offset unavoidable impacts to listed bats. During forest enhancement activities, general wildlife could be temporarily displaced or harmed through selective tree cutting or invasives removal. However, the overall mitigation actions are expected to improve the quality of the habitat, and therefore a net positive impact on general wildlife can be expected. Alternative 2 would implement similar measures mitigation. Terrestrial wildlife species may benefit from measures to protect or restore summer habitat for covered species.

4.3.1.3 Summary of Effects to General Wildlife

Project operations under any considered alternative are not expected to result in impacts to general wildlife. The Service does not expect Project operations to substantially affect a species' population (locally, regionally, or rangewide) or significantly reduce its habitat quality or quantity. Among the three alternatives, we do not expect Project operations, maintenance, and decommissioning to have significantly different effects to terrestrial wildlife. Similarly, we do not expect significant differences in effects to general wildlife resulting from the mitigation measures for listed bats.

4.3.2 Avian Resources

4.3.2.1 Impact Criteria

Federally listed birds are protected under the ESA. The BGEPA protects bald and golden eagles. The MBTA affords protection of native migratory birds. As per NEPA and CEQ guidelines, the human environment includes avian resources. Under Executive Order 13186, federal agencies are expected to carry out, among other things, the following:

1) Ensure that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern; and,
2) Identify where unintentional take reasonably attributable to agency actions is having, or is likely to have, a measurable negative effect on migratory bird populations, focusing first on species of concern, priority habitats, and key risk factors.

Birds can be affected at the individual and population-level. Impacts to avian resources would be considered significant should implementation of an alternative result in any of the following:

1) Naturally occurring population reduced in numbers below levels for maintaining viability at local or regional level;
2) Substantial loss or degradation of habitat for a rare, threatened, or endangered bird species; or
3) Substantial change in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels.

In the Project area impacts to birds may occur as a result of turbine interactions (e.g., direct mortality, displacement, or avoidance).

4.3.2.2 Direct and Indirect Effects Common to All Alternatives

Project Operations

Operation of the Project under any of the three alternatives is expected to have similar effects on avian resources. For the purposes of our analysis and based on currently available information, we assumed operational differences among alternatives (i.e., turbine cut-in speeds) would not result in different potential direct or indirect impacts to avian resources. To date, very few studies in the U.S. focused on effects of turbine operational adjustments on bird mortality. The effectiveness of turbine curtailment, feathering, and shutdown for reducing bird mortality has been inconclusive and likely would be site- and species-specific.

Impacts to avian species due to wind project operations include mortality, injury, disturbance, habitat loss and alteration, and avoidance or displacement due to habitat loss and alteration.

This EA considers Hoopeston Wind's best management practices and impact minimization efforts related to birds during Project planning and development. These best management practices and minimization efforts are summarized in the Project BBCS. Prior to field surveys, the Applicant conducted informal consultation with the Service and IDNR to identify species of concern with potential to occur within Vermilion County and within the Project area. Recommendations by both agencies were considered during protocol development for field surveys. The goals of the surveys were to describe the bird and bat resources present at the Project in the context of the proposed development, to assist in addressing potential impacts from the development, and to the extent possible, assist in the Project design/layout and siting that minimizes risk to avian and bat resources (e.g., wetland impacts/avoidance) (Ecosystem Management, LLC 2011). Hoopeston Wind conducted bird surveys in 2009 and 2010. Surveys sampled breeding, migratory, and winter bird activity.

Disturbance and Displacement

Avian species in the Project area may be susceptible to disturbance and displacement-related impacts during Project operations. Potential sources of disturbance include the presence of Project structures (particularly operating turbines and the MET tower), human presence, vehicle traffic during maintenance activities, and noise associated with spinning turbines. Other disturbances could include long- and short-term habitat alterations. The level of disturbance associated with habitat impacts at wind projects relates to the topography, baseline condition of habitat(s) present, extent of existing roads or infrastructure, and turbine layout (NRC 2007). Potential habitat disturbances are species-specific and would depend on the condition and availability of habitat prior to construction (NRC 2007). The Project largely consists of active agricultural fields and does not contribute to forest fragmentation and associated impacts to birds. A smaller portion of the Project contains forest, hedgerows, and herbaceous fields, along with streams, drainages, creeks, and associated wetlands. Disturbance effects at the Project area will vary among species and habitats. Species with specific breeding habitat requirements, species of conservation concern, or species with specific migratory stopover habitat requirements, may be at increased risk of disturbance or displacement.

Available literature suggests that varying degrees of bird displacement have been documented at operational wind projects. Observed effects vary among bird groups and species. Displacement effects can impact breeding birds, but also migrating, nesting, and foraging birds (Johnson et al. 2000, Strickland 2004). Displacement effects can occur at distances from roughly 250–2,600 feet from turbines (Strickland 2004).

Wind project effects on grassland species vary among studies and sites. At the Buffalo Ridge Wind Resource Area in Minnesota, grassland nesting birds were less dense in study plots near turbines than in reference plots (Leddy et al. 1999). However, displacement effects were considered small-scale, occurring out to a maximum distance of approximately 328 feet (Johnson et al. 2000). At a wind project in North and South Dakota, species such as grasshopper sparrow (*Ammodramus savannarum*) and clay-colored sparrow (*Spizella pallida*) appeared to avoid turbine areas (Poulton 2010).

Species that have not shown avoidance of wind turbines include waterfowl and some ground-nesting birds. At Buffalo Ridge in Minnesota, waterfowl continued to nest in the area; a mallard pair (*Anas platyrhynchos*) nested 100 feet from a turbine (Osborn et al. 1998). At a wind project in North and South Dakota, species including killdeer (*Charadrius vociferus*), western meadowlark (*Sturnella neglecta*), and chestnut-collared longspur (*Calcarius ornatus*) did not show any avoidance to wind turbines, and killdeer appeared to be attracted to the bare ground surrounding turbine areas (Poulton 2010). Killdeer and their young at 2 projects in New York came close to turbines (Stantec, unpublished data). At the Cohocton and

Dutch Hill Wind Project in western New York, observers documented successful nests of horned lark, savannah sparrow, vesper sparrow, and dark-eyed junco (*Junco hyemalis*) approximately 100 feet to 260 feet from operating turbines (Stantec 2010*a*). A red-winged blackbird (*Agelaius phoeniceus*) nested in a hayfield within 164 feet of a turbine at the Steel Winds Wind Project along Lake Erie (Stantec, unpublished data). We expect some ground nesting species, such as horned lark and killdeer, to continue to breed in the Project area and possibly relatively close to turbines. Similarly, nesting Savannah sparrow (*Passerculus sandwichensis*) did not exhibit observable displacement effects due to the presence of turbines at the Maple Ridge Wind Project in New York (Kerlinger and Dowdell 2008). Nesting bobolinks (*Dolichonyx oryzivorus*) were minimally affected at distances within 328 feet from turbines (Kerlinger and Dowdell 2008). Other studies conducted in Wisconsin and Iowa reported no clear relationships between bird abundance in turbine areas compared to reference areas, and results varied among survey years (Poulton 2010).

Observed impacts to raptors vary among wind projects. Researchers found no raptor nests where they expected to find nests during the first 2 years of monitoring at Buffalo Ridge (Usgaard et al. 1997). At the Montezuma Wind Project in California, observers found a similar number of nests before and after construction of the wind farm (Howell and Noone 1992 as cited by Strickland 2004, and wind projects in Oregon and Wyoming documented successful breeding of raptors within 1 mile of turbines (Strickland 2004). In forested and agricultural settings in the eastern U.S., records showed raptors foraging in areas proximal to wind projects. At Cohocton/Dutch Hill in New York and Stetson I in Maine, post-construction searchers recorded a variety of raptor species foraging and perching within the Project area (Stantec 2010*a*, *b*). Species included red-tailed hawk, northern harrier, turkey vulture, sharp-shinned hawk (*Accipiter striatus*), and American kestrel.

Project turbines are not sited near sizable wetlands that could attract migrant waterfowl or wading birds. Flocking species, such as Canada geese, that stopover in the Project area, likely will not be disturbed or displaced by Project operations because they are tolerant of human-disturbed environments. Species that used the agricultural portions of the Project area for foraging, resting, or roosting prior to Project construction are generally common, regionally abundant species that in general, show little response to human-related disturbances. Brown-headed cowbird, horned lark, and red-winged blackbird, all abundant species within the Project area, are known to regularly use human-altered and disturbed habitats. One exception may be American golden-plover. Though the Project does not contain an IBA site of global importance to American golden-plover (i.e., the site contains 2,000 birds or more) (Clay et al. 2010), roughly 1,700 American golden-plovers were observed during pre-construction bird surveys conducted in 2009 and 2010. This species was the most abundant species observed at the Project. Several flocks of varying numbers were observed, particularly during spring migration. American golden-plovers are known to stopover in counties in west central Indiana and east-central Illinois (Clay et al. 2010, Stodola et al. 2014) during their spring migration from northeastern South America to the Arctic coastal plain. American golden-plovers remain in the region for approximately 45 days; individuals spend on average 24 days in the region before migrating to the northwest (Stodola et al. 2014). During a period of peak migration, golden-plovers preferred fields with standing water and, to a lesser extent, soybean fields (Stodola et al. 2014). Disturbance or displacement to the American golden-plover from habitats in the Project area is unknown. No studies have been conducted assessing migrant or breeding activity post-construction. A single study quantified a displacement effects for this species and found it to be 0.5 miles from a wind project (Manes et al. 2004 as cited by Ecosystem Management 2011).

Project turbines have not eliminated but possibly degraded stopover habitat for this species. Considering the wide range of this plover’s migration route and the predominance of soybean and corn fields throughout Illinois and the Midwest, displacement of the American golden-plover from the Project would not adversely impact the species.

Regardless, the Applicant, in consultation with the Service, has proposed to conduct studies to compare pre-construction use of the site by American golden-plovers to post-construction use. At a rate of 3 times per week for 4 weeks per year from April 15 to May 15, observers will drive a single survey route within and adjacent to the Project site along existing roads. The observer will stop at 1-mile intervals for 2 minutes to record any American golden-plovers seen. Data recorded will include flock size, location, behavior, habitat, and weather (Project BBCS, Appendix A).

The Project area contains foraging habitat but low-quality breeding habitat for raptors. Raptor species observed during pre-construction surveys at the Project, such as American kestrel, Cooper's hawk, northern harrier, red-shouldered hawk, red-tailed hawk, rough-legged hawk, and turkey vulture, are likely to use the Project area for foraging. Other species observed such as broad-winged hawk and red-shouldered hawk likely occur in the Project area only during migration. No bald eagles were observed at the Project. They could occur during migration. Golden eagles could occur as rare vagrants.

Operational turbines have the potential to obstruct the flight paths of migrants to the extent that birds may alter their flight path around the Project area. Flocks of Canada geese have been observed altering their flight paths to fly around wind projects rather than pass over them (Stantec, unpublished data). This avoidance could result in increased energy expenditure and possibly reduced survivorship. However, most migrants are expected to fly well above the height of the turbines during migration, thereby avoiding them. Further, the turbines are widely spaced in agricultural fields, so birds may fly between them.

Turbine-Related Mortality

Avian collision mortality at wind projects is well documented. Smallwood (2013) estimated 573,000 bird fatalities per year (with 83,000 raptor fatalities) at 51,630 MW of installed wind-energy capacity in the U.S. as of 2012. We considered mortality estimates from wind projects in different regions of the U.S., with weighted averages ranging from 1.5 birds per turbine per year in the Rocky Mountains to 4.27 birds per turbine per year in the east (NRC 2007). Regardless of the region, nocturnal migrating passerines represent the bird group most commonly involved in fatalities at wind-energy facilities (NRC 2007, Erickson et al. 2014). This is likely due to their abundance and migratory behaviors. Erickson et al. (2014) estimated that 62.5% of reported bird fatalities from wind projects in the U.S. and Canada consist of small passerines. For all wind projects currently operating in North America, Erickson et al. (2014) estimated there are 2.10 – 3.35 passerine fatalities per installed MW per year. Avian collision mortality occurs year-round, but observed mortality at communication towers, buildings, wind turbines, and other man-made structures suggest that the majority of fatalities occur during spring and fall migration (NRC 2007).

Birds have demonstrated turbine avoidance behaviors at operational projects, and this ability likely depends on a variety of factors. Some studies have attempted to quantify or estimate turbine avoidance rates, through either visual observation or computer modeling. The limitations to turbine avoidance estimates include failure to account for differences among bird flight patterns and behaviors under a range of conditions, as well as a general lack of information and data about avoidance behaviors of many species of birds (Chamberlain et al. 2006). Birds presumably avoid encountering turbines during the day by seeing the blades or detecting the motion of spinning blades, or by hearing them (Dooling 2002). Osborn et al. (1998) studied turbine avoidance behavior by birds at the Buffalo Ridge Wind Project using visual observations. Birds seen flying through turbine strings in daylight often adjusted their flight when turbine blades were rotating and typically made no adjustments when turbines were not operating (Osborn et al. 1998). Fernley et al. (2006) estimated the avoidance rates of geese and raptor species to be greater than 95% (Fernley et al. 2006). Despite high numbers of golden eagle fatalities at Altamont Pass (Thelander et al. 2003, Smallwood and Thelander 2004), the avoidance rate for golden eagles at that site were estimated to be >99% (Fernley 2008 as cited by Whitfield 2009). Using a method often referred to as the "Band Collision Risk Model," Whitfield (2009) analyzed eagle observation data at 4 projects

(Altamont, Tehachapi, San Gorgonio, and Foote Creek Rim) and estimated a 99% avoidance rate for golden eagles.

Birds traveling at high altitudes (>600 feet) would avoid colliding with turbines. Conversely, birds that migrate at night and fly at lower altitudes are at greater risk of collision. As at other wind projects, bird flight behaviors are expected to influence their risk of collision. Also, migrant passerines are expected to comprise the majority of fatalities, and are most at risk of collision with turbines when taking off or landing, or if flying low during inclement weather (rain or fog) at night. Local birds or stopover birds are at lower risk of collision when making small-scale flights at low altitudes between foraging and roosting locations in the area, as they typically remain below the rotor-swept height during these activities. Most species of birds flying below rotor-zone during periods of good visibility generally will avoid turbine collisions. However, birds foraging at heights within the rotor-zone may be more at risk when distracted by prey. Birds engaged in territorial or courtship flights can be distracted putting these individuals at risk of collision if distracted when flying through the rotor swept zone.

A study of European golden-plovers (*Pluvialis apricaria*) indicated that they are at high risk for collision by turbines (Pearce-Higgins et al. 2008). However, no American golden-plover fatalities have been detected at wind projects in 17 states and 1 province (Ontario) based on publicly available post-construction monitoring results.

For the Project, post-construction monitoring in fall 2015 recorded no bird carcasses, and monitoring in spring 2016 recorded two bird carcasses, one sora (*Porzana carolina*) and one European starling (Ritzert et al. 2016). These results indicate bird mortality rates at the Project are low compared to other projects in the region. However, Ritzert et al (2016) did not provide a bird fatality rate for the Project. To derive an expected bird fatality rate for the Project, we used bird fatality estimates from 2009 monitoring at Fowler Ridge in Benton County, Indiana: 5.26 birds per turbine per year and 2.63 birds per MW per year. We expect bird fatality rates at the Project to be comparable to those reported for Fowler Ridge. The two projects are proximal to each other (within 20 miles), set in similar landscapes, and have similar land cover types. Unlike Fowler Ridge, the Project is not proximal to any IBAs and does not have unique landscape or aerosphere features that would tend to attract birds to the site.

Based on the mortality rate of 5.26 birds per turbine per year (or 2.63 birds per MW per year), the Project is expected to kill approximately 258 birds annually and 7,732 birds over the life of the Project. This mortality is expected to occur under any of the three alternatives.

Likely affected species will be those discovered during post-construction monitoring at other projects in the region in agricultural landscapes, such as migrants (vireos and warblers), swallows, and to a lesser extent, waterfowl and raptors.

Population-level Impacts

Species considered at risk from population-level effects would include those with relatively small or unstable populations. To date, no significant population level impact to any one species has been documented as a result of mortality from wind projects. This is largely because most of the nocturnal migrant passerines, which are at the greatest risk of collision, are considered to be abundant wherever they occur (NRC 2007, Johnson et al. 2002, Arnold and Zink 2011).

Available data suggest the species most at risk of collision are those that are regionally abundant and engage in flight behaviors leading to risk of collision and those that migrate through the area at night at lower altitudes. The summary by Erickson et al. (2014) indicates that the 3 species most frequently involved in collisions at wind projects in the U.S. and Canada include horned lark, red-eyed vireo (*Vireo olivaceus*), and western meadowlark (*Sturnella neglecta*). The Partners in Flight (PIF) landbird population database estimates for the North American populations (PIF Science Committee 2013) of these species are provided in Table 4-1. The global population of red-eyed vireos appears to be stable. However, the

PIF species assessment database shows horned larks and western meadowlarks have experienced decreases in populations in recent years (PIF Science Committee 2013).

Table 4-1. North American population estimates for three regionally abundant species that have been involved in collision mortality at wind projects in North America.

Species	North American estimate [1]
horned lark	80 million
red-eyed vireo	130 million
western meadowlark	79 million

[1] PIF Science Committee. 2013. Population estimates database, version 2013. <http://rmbo.org/pifpopestimates/>. Accessed on 4 November 2015.

Erickson et al. (2014) indicated that compared to their North American populations estimates, the cumulative fatality rate per year by species was highest for black-throated blue warblers (*Setophaga caerulescens*) and tree swallow (*Tachycineta bicolor*); 0.043% of the entire population of these species was estimated to die annually as a result of collision with wind turbines. The North American population of black-throated blue warbler is 2.1 million and the North American population of tree swallow is 17 million (PIF Science Committee 2013). At this time, this level of take is not considered a population-level impact. However, as the number of wind facilities increases in North America, the take of these species is expected to increase proportionally in those areas where these species overlap with wind projects.

<u>State-listed Species</u>

The state-protected species in Vermilion County include short-eared owl, upland sandpiper, northern harrier, and least bittern. To date, at operational wind projects for which post-construction data are publicly available, 1 short-eared owl fatality was detected in Nebraska (Derby et al. 2007), 4 upland sandpiper fatalities were detected in Ontario (Stantec 2010*c*, 2011*a*), and 1 northern harrier fatality was detected in Ontario (Stantec 2011*a*).

Pre-construction and post-construction surveys did not detect short-eared owls. It is possible that this species could collide with Project turbines, but based on the lack of fatalities in Iowa, Illinois, and Indiana wind projects, fatalities would likely be rare events.

Upland sandpipers have not been detected during spring bird counts in Vermilion County since 1994. However, this species is difficult to detect during morning auditory surveys. The Project contains habitat with potential to support this species during both the breeding season and during stopover migratory flights. Upland sandpipers migrate over the Midwest and largely at night (Palmer 1967 as cited by Houston et al. 2011). It is possible that this species could collide with Project turbines. However, based on the lack of fatalities in Iowa, Illinois, and Indiana wind projects, collisions are expected to be rare events.

Observers recorded 18 northern harrier observations during avian point counts at the Project in 2009 and 2010. Detections of this species were highest in fall, and individuals' flight heights were below turbine height (Ecosystem Management 2011). The Project area contains habitat suitable for nesting, migrating, and wintering harriers. Although northern harriers commonly migrate through and winter in Illinois, collisions of this species are expected to be rare events. The Project could disturb and displace northern harriers foraging or stopping over. However, these effects would be minimal because proximal agricultural habitat is abundant.

To date, least bitterns have not been observed at the Project during either pre- or post-construction monitoring.

The Project was designed with impact minimization measures to reduce the risk of avian collision. The new generation turbines have tubular support structures instead of lattice structures, which eliminate perching by avian species such as raptors. Newer turbines also have larger blades, which reduces motion blur, allowing diurnal bird species to see them. The turbines also are adequately spaced within crop fields, allowing birds greater reaction times to avoid turbines when approaching them.

Birds of Conservation Concern

Four bird species of conservation concern were observed either in or flying over the Project area: cerulean warbler (6), dickcissel (18), northern flicker (5), and solitary sandpiper (1). Publicly available data from post-construction monitoring at wind projects in the Midwest include records of two dickcissel fatalities (Derby et al. 2007, Johnson et al. 2000). Two northern flicker fatalities were documented at New York projects (Jain et al. 2009, 2011) and two were documented in Ontario (Stantec 2010*c*, 2011*a*). No fatalities of these species have been documented at the Project to date.

Cerulean warbler and solitary sandpiper fatalities are expected to be rare, and to our knowledge fatalities of these species have not been found to date at wind energy projects with publicly available data. It is possible that dickcissel and northern flicker fatalities may occur at the Project, and all four of these species may be disturbed or displaced by operational turbines. To date, post-construction monitoring at the Project has not detect cerulean warbler, solitary sandpiper, dickcissel, or flicker carcasses.

Other Sources of Mortality Associated with Project Operations

Birds are susceptible to other sources of mortality at wind projects beyond turbine collision. Other sources of mortality include collision with maintenance vehicles, collision or electrocution from transmission lines, and collisions with other project structures, such as MET towers. Additionally, nighttime lighting that is improperly installed or operated at wind facility substations or Operations and Maintenance buildings can increase the risk of collision with Project structures or nearby turbines.

Vehicle Collisions

Birds may be susceptible to collision with maintenance vehicles when crossing roads within the Project area. Avian-vehicle collisions have been reported at other operational wind projects, but they represent a smaller proportion of fatalities than turbine collisions (Stantec, unpublished data). Implementing a slower traffic speed in the Project area, such as 15 mph, would allow for birds to better detect and avoid a vehicle and drivers to slow when approaching birds on roadways. In addition, the Project is properly managing garbage and waste disposal to avoid attracting wildlife to roadways (Project BBCS).

Transmission Line Collisions and Electrocutions

Transmission lines present a collision and electrocution risk to birds including passerines, waterfowl, and raptors. To minimize the collision and electrocution risk, Hoopeston Wind buried the Project's collector lines and designed elevated lines in accordance with the Avian Power Line Interaction Committee guidelines (APLIC 2006) as indicated in the Project BBCS.

Collisions with MET towers

Collisions with MET towers at wind projects have been well documented, and in some cases, collisions with guyed MET towers have represented greater risk of avian collision than wind turbines (Johnson et al. 2000). Avian risk of collision fatality at towers (including MET towers and communication towers) varies depending on tower height, lighting, color, structure, and the presence of guy wires (Erickson et al. 2001). Avian risk increases with tower height (Longcore et al. 2008). Guywires substantially increase the risk of avian collision; birds are suspected to collide more frequently with guywires and not as frequently with the tower itself evidenced by documented collisions being substantially lower at unguyed towers (Longcore et al. 2008). The Project area has one meteorological tower; it is 95 meters (312 feet) tall, self-supporting (i.e., unguyed), and a lattice, steel structure. Because the tower is unguyed, the bird collision risk is substantially reduced.

Wind Facility Lighting

Nocturnal migrants aggregate at artificial light sources when they become disoriented or “trapped” by lights (Longcore et al. 2008). The potential for this phenomenon to occur is increased when fog is present to reflect the light and when inclement weather or topographic factors influence migrating birds to fly at lower heights above ground level (Longcore et al. 2008). Post-construction studies have documented avian fatality events caused by facility lighting at night (such as steady burning lights at substations or Operations and Maintenance buildings, or lighting above tower doors) during periods of inclement weather (e.g., rain or fog). Facility lighting has resulted in large fatality events (from 33 to 500 birds in a single night) at 3 facilities in West Virginia (Kerns and Kerlinger 2004, Young et al. 2010, Kerlinger et al. 2010, Stantec 2011*b*).

Current federal regulations specify the use of nighttime lighting for aviation safety on all structures greater than 200 feet above ground level (Longcore et al. 2008). Strobe or flashing lights on towers decrease the risk of bird collisions compared to steady-burning lights (Longcore et al. 2008). Kerlinger et al. 2010 found no significant difference between fatality rates at turbines with FAA lights as opposed to turbines without FAA lighting.

Potential nighttime lighting impacts have been minimized at the Project. The Applicant designed the turbine lighting schemes at the Project to minimize the risk to nocturnal migrants. FAA lighting at the Project is not expected to increase risk of collision to nocturnal migrants. Lighting at operation and maintenance facilities and substations were minimized and directed downward (Project BBCS).

Project Maintenance

Maintenance effects on birds may include disturbance and possible mortality. Birds may be displaced due to human activity and the presence of large equipment (e.g., cranes). These impacts are expected to be minimal and temporary and would occur only when personnel are on-site for maintenance activities. Birds are expected to return to the disrupted area after maintenance activities end. Many species that occur in the Project area commonly occupy human-disturbed habitats and are tolerant of some human activity. Other species are more sensitive to human presence and could be displaced. However, as maintenance activities are expected to be temporary, substantial impacts associated with disturbance and displacement are not expected. If a more long-term maintenance activity is required (e.g., blade repair or replacement), some species may be displaced from the area for the duration of the activity. The habitat in the Project area is relatively uniform and therefore birds would be expected to utilize similar surrounding habitat if displaced from the immediate area.

If a crane or other large equipment is required, there may be risk of mortality or decreased nesting success for birds breeding in the immediate area. Possible species impacted could include horned lark or killdeer which may nest on the bare ground surrounding towers. Nests or nestlings could be destroyed. However, the use of large equipment to maintain turbines is expected to occur infrequently. Most turbine maintenance happens by accessing the nacelle through the ladder located inside the tower. Therefore, impacts associated with decreased nesting success are expected to be minimal.

Birds could collide with large equipment such as cranes. Further, if lighting at towers is required for nighttime maintenance activities during rain or fog conditions, there may be an increased risk of avian collisions with towers or nearby equipment. These risks would be short-term and temporary. Therefore, impacts associated with collision impacts during maintenance are expected to be minimal.

Birds also could collide with maintenance vehicles or flush as maintenance vehicles drive by them. Slower traffic speeds would allow for birds to detect approaching vehicles from a greater distance, affording them more time to leave the immediate area. Slowly approaching vehicles allow drivers to slow when approaching birds on roadways or when groups of birds fly across roadways. As such, impacts associated with maintenance vehicle collisions are expected to be minimal.

Post-construction Monitoring

All three alternatives would include post-construction monitoring to be conducted according to the Project BBCS or Project HCP. Effects to birds resulting from post construction monitoring may include disturbance or fatality due to increased vehicle traffic and human presence. Also, any vehicle-induced animal fatalities may attract scavengers, and avian scavengers could collide with spinning turbine blades while attempting to feed on carcasses.

Post-construction monitoring also includes searcher efficiency and carcass persistence trials, in which carcasses are placed in the Project area to assess searcher success and carcass removal by scavengers (i.e., mammals and birds). Local scavenging birds, such as vultures, raptors, and crows may be attracted to the Project area during either of these types of trials. Cleared turbine pads would make fatalities easily detectable to birds. Avian scavengers could collide with spinning turbine blades while attempting to scavenge a carcass.

Project Decommissioning

Decommissioning effects may include disturbance and fatality related to human activity, the presence of large equipment, nighttime lighting, and increased vehicle traffic. After decommissioning, the habitat and land-use activities would be restored to pre-construction conditions or as per landowner wishes. Impacts to birds associated with decommissioning activities at the Project are expected to be minimal and generally short term. Adverse impacts to birds are not expected from decommissioning of the Project.

Mitigation

Mitigation measures for listed bats may include protecting and/or restoring forested habitat. Any forest protection or restoration would benefit forest-breeding birds and birds that use forest as stopover habitat during migration. Though most of the species documented at the Project use open habitats, some raptor species such as broad-winged hawk, Cooper's hawk, and red-shouldered hawk could benefit from the breeding, foraging, and stopover opportunities in the protected or restored forested habitat. Woodpeckers and passerines observed at the Project that also could benefit from protected forested habitat include red-bellied woodpecker (*Melanerpes carolinus*), American robin (*Turdus migratorius*), brown thrasher (*Toxostoma rufum*), eastern towhee (*Pipilo erythrophthalmus*), golden-crowned kinglet (*Regulus satrapa*), house wren (*Troglodytes aedon*), northern cardinal (*Cardinalis cardinalis*), red-eyed vireo, summer tanager (*Piranga rubra*), and yellow-rumped warbler (*Setophaga coronata*).

4.3.2.3 Summary of the Effects on Avian Resources

No significant adverse effects to the local bird community are anticipated under any of the three alternatives due to relatively low known collision rates compared to population size and the presence of similar habitat adjacent to permanently disturbed areas. Implementation of any of the three alternatives is not expected to result in substantial loss or degradation of habitat for rare, threatened, or endangered bird species.

During each year of operation, we anticipate that the bird fatality rate will be around 5.26 birds per turbine per year (based on the rates observed at Fowler Ridge in 2009) and 2.63 birds per MW per year, or approximately 258 birds per year. Likely affected species will be those discovered during post-construction monitoring at other projects in the region. Based on the mean mortality rate of 5.26 birds per turbine per year, the Project is expected to kill approximately 7,700 birds over the life of the Project. This mortality is expected to occur under any of the three alternatives.

We do not anticipate the Project will have adverse population-level impacts to individual species under any of the alternatives. Implementation of any of the alternatives would not result in reducing any naturally occurring population to numbers below that for maintaining viability at the local or regional level. None of the alternatives would result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. Any potential cumulative impacts to bird populations from wind energy development are addressed in Section 4.5.

No impacts to bald eagles or golden eagles from the Project are anticipated based on the location of the Project area and the lack of eagle observations during on-site surveys.

Impacts to American golden-plovers may include stopover habitat displacement. However, stopover habitat in the region is not limited, and displaced birds likely will seek similar habitat proximal to the Project area.

The Service does not expect that maintenance and decommissioning activities will have significant adverse effects to the resident bird community or for any bird species.

In summary, among the three alternatives, we do not expect Project operations, maintenance, post-construction monitoring, decommissioning, and mitigation to have significantly adverse effects to avian resources. No specific mitigation measures for birds would be implemented under any of the three alternatives.

4.3.3 Bat Resources

4.3.3.1 Impact Criteria

The following sections analyze potential impacts of each alternative on listed and unlisted bats. The federally listed Indiana bat is protected under the ESA and is also the only bat species with potential to occur in the Project area that is protected by Illinois state law. The northern long-eared bat is listed as threatened under the ESA as of May 4, 2015. With the exception of the Indiana bat, reliable population data are lacking for bats. Therefore, although we discuss all bat species, we can confidently assess the effects of the alternatives to the population viability for only the Indiana bat for which we have adequate population data from hibernacula counts. As discussed in Section 2.4 of the Programmatic Biological Opinion on the final 4(d) rule (USFWS 2016*b*) and summarized in Section 3.3.3.3 of this EA, the Service has derived state and rangewide population estimates for the northern long-eared bat using a series of calculations based on a number of assumptions rather than direct counts. We are able to put in context the effects of the alternatives on the population of northern long-eared bat, but we do so with less certainty.

Significant impacts to bats would result should implementation of an alternative result in any of the following:

1) Observed Project mortality rates greatly exceed the estimated rate for a wind project in the region;
2) Substantial loss or degradation of habitat;
3) Substantial change in habitat conditions producing indirect effects that result in additive reductions in naturally occurring populations; or
4) Substantial mortality resulting in reduction of naturally occurring populations below levels for maintaining viability at local or regional levels.

4.3.3.2 General Bat Mortality Patterns at Wind Projects

Bat mortality at rates of concern to wildlife agencies has occurred at commercial wind projects throughout the Midwest and eastern U.S. Mechanisms for bat mortality at wind turbines include trauma associated with direct collision with spinning turbine blades and barotrauma (i.e., tissue damage to lungs and respiratory organs that occurs when bats fly through a wake of low pressure that follows immediately behind fast-moving turbine blades). Barotrauma can cause mortality even when bats do not physically collide with turbine blades, as was the case for an estimated 50% of carcasses recovered during a mortality study at a wind farm in Alberta, Canada (Baerwald 2008). More recent research found that the majority of the turbine-associated bat deaths are attributed to impact trauma (Houck et al. 2012, Rollins et al. 2012). Bats do not appear to be at risk of mortality when turbines are fully feathered (blades pitched to rotate at <2 revolutions per minute when wind speeds are below the indicated cut-in speed).

Migratory tree-roosting bats consistently account for the majority of fatalities in studies of wind farm mortality in the U.S. (Arnett et al. 2008, Arnett and Baerwald 2013). This pattern occurred during each of 3 years of post-construction monitoring at Fowler Ridge (Johnson et al. 2010; Good et al. 2011, 2012), approximately 13 miles northeast of the Project area. Migratory tree bats account for 87% of bat mortality among 8 wind projects in the Midwest (Table 4-2).

Table 4-2. Species composition of bat carcasses found and identified at wind projects in the Midwest that provided publicly available post-construction monitoring reports.

Project	State	Carcasses identified	Migratory tree-roosting [1]	Cave-hibernating [2]	Reference
Buffalo Ridge, Phases I-III	MN	163	93%	7%	Johnson et al. (2003)
Buffalo Ridge, Lake Benton I & II	MN	151	93%	7%	Johnson et al. (2004)
Blue Sky Green Field	WI	235	50%	50%	Gruver et al. (2009)
Kewaunee County	WI	72	90%	10%	Howe et al. (2002)
Cedar Ridge	WI	215	73%	27%	BHE (2010)
Crescent Ridge	IL	20	100%	0%	Kerlinger et al. (2007)
Top of Iowa	IA	76	64%	36%	Jain (2005)
Forward Energy Center	WI	108	78%	22%	Grodsky and Drake (2011)
Fowler Ridge	IN	809	95%	5%	Good et al. (2011)
Fowler Ridge	IN	573	96%	4%	Good et al. (2012)
Total		2,422	87%	13%	

[1] Hoary bat, eastern red bat, silver-haired bat, Seminole bat (*Lasiurus seminolus*)
[2] *Myotis* species, big brown bat, tri-colored bat, evening bat

Seasonal timing of bat mortality has also been consistent among wind projects, with most mortality occurring during the presumed fall migratory period between mid-August and mid-October (Arnett and

Baerwald 2013). At Fowler Ridge, 90% of estimated bat mortality occurred between August 1 and October 15 (Good et al. 2012). Typically, wind farm mortality records do not show a comparable spring peak in collision mortality even though bats also migrate during spring. Although reasons for this remain unclear, factors may include differing flight heights during spring and fall migration, different spring and fall migration routes, or mating behavior and courtship flight during fall migration (Cryan 2008, Johnson et al. 2011). Migratory tree bats are expected to account for the majority of bat mortality under any of the alternatives.

To date, post-construction studies have documented 7 Indiana bat mortalities at 5 wind projects in the U.S. (Table 4-3). Due to the infrequency of Indiana bat mortality, risk factors for this species at wind projects are poorly understood. Patterns of mortality in similar species such as little brown bats have been used to quantify potential Indiana bat mortality rates and to predict mortality patterns. Of the 7 documented Indiana bat mortalities, 5 occurred during the fall migration, 1 in late-summer, and 1 in spring.

Table 4-3. Documented individual Indiana bat mortalities at wind projects in the U.S.

Site	Location	Estimated Date	Reference
Fowler Ridge (BP Wind Energy)	Benton County, IN	September 8-9, 2009	Good et al. (2012)
Fowler Ridge (BP Wind Energy)	Benton County, IN	September 17, 2010	Good et al. (2012)
North Allegheny (Duke Energy)	Cambria and Blair Counties, PA	September 25, 2011	USFWS (2011)
Laurel Mountain (AES Corporation)	Randolph and Barbour Counties, WV	July 7, 2012	USFWS (2012*a*)
Blue Creek (Iberdrola)	Van Wert and Paulding Counties, OH	October 2-3, 2012	USFWS (2012*b*)
Undisclosed site	Paulding County, OH	October 7-9, 2013	M. Reed, USFWS, pers. comm.
Undisclosed site	Paulding County, OH	April 13-14, 2014	M. Reed, USFWS, pers. comm.

To date, post-construction studies have documented 41 northern long-eared bats at wind-energy facilities in North America (Table 4-4). The northern long-eared bat was not listed or proposed for listing when any of these fatalities occurred.

Table 4-4. Summary of publicly available documented northern long-eared bat mortalities at wind projects in the U.S. and Canada.

Site	Location	Number	Dates Found	Reference
Mountaineer (NextEra)	Tucker County, WV	6	Aug 18, 2003	Kerns and Kerlinger (2004)
Meyersdale (NextEra)	Somerset County, PA	2	Sep 11, 13, 2004	Arnett et al. (2005)
Kingsbridge I (Capital Power)	Huron County, ON	1	Oct 5, 2006	Stantec (2007)
Erie Shores (Aim Power Gen, now Capstone)	Norfolk County, ON	6	May 25, Jun 11, 12, Aug 28, 30, 2007	James (2008)
Steel Winds (First Wind now SunEdison)	Erie County, NY	6	2007	NYSDEC, pers. comm.[1]
Ripley (Suncor/Acciona)	Bruce County, ON	2	Aug 4, Sep 5, 2008	Jacques Whitford (2009)
Mount Storm (NedPower)	Grant County, WV	1	Aug 26, 2008	Young et al. (2009)
Ellenburg (Noble)	Clinton County, NY	1	Aug 2008	Jain et al. (2009)
Fowler Ridge (BP Wind Energy)	Benton County, IN	1	Aug 25, 2009	Good et al. (2011)
PA Site 2-14	PA	1	Sep 2009	J. Taucher, PGC, pers. comm.
Undisclosed site	MO	1	2009	M. Turner, USFWS, pers. comm.
Cohocton/Dutch Hill (First Wind)	Steuben County, NY	1	Jun 22, 2010	Stantec (2011*c*)
Wethersfield (Noble)	Wyoming County, NY	6	Jun 11, 2010 Jul 17, Aug 6, 18, Sep 2, 3, 2011	Jain et al. (2011), Kerlinger et al. (2011)
Undisclosed site	PA	1	Jul 2012	J. Taucher, PGC, pers. comm.
Undisclosed site	IA	1	Aug 10, 2013	M. Turner, USFWS, pers. comm.
Undisclosed site	IA	1	Aug 22, 2013	M. Turner, USFWS, pers. comm.
Undisclosed site	IL	1	Sep 25, 2013	M. Turner, USFWS, pers. comm.
Undisclosed site	MI	1	Jul 10, 2014	M. Turner, USFWS, pers. comm.
California Ridge (Invenergy)	Champaign and Vermilion County, IL	1	Fall 2014	K. Shank, IDNR, pers.comm.
	Total	**41**		

[1] NYSDEC identified the bat species for this survey and provided the information via personal communication; species were not disclosed in original study report.

While species composition and seasonal timing of bat mortality have been consistent across wind projects, magnitude of bat mortality, usually expressed as the estimated number of bats killed per MW or per turbine, has varied among projects and across regions. Estimated bat fatality rates have been lower at wind projects in agricultural landscapes of the Midwest versus those on forested ridges in the Appalachians. Estimated bat mortality rates in the Midwest ranged from 1.4 – 30.6 bats per MW per survey period for studies conducted in the Midwest between 1999 and 2014 (Table 4-5). The arithmetic mean among studies listed in Table 4-5 is roughly 12.6 bats per MW per study.

Table 4-5. Bat mortality estimates for wind projects in the Midwest with publicly available post construction monitoring reports. Fatality rates were averaged across multiple survey years.

Site	State	MW	Fatalities per MW per study[1]	Study Period	Reference
Buffalo Ridge, Phases I, II, & III	MN	235.6	2.3	Mar 15 – Nov 15, 1996 Mar 15 – Nov 15, 1999	Johnson et al. (2003)
Buffalo Ridge, Lake Benton I & II	MN	210.8	2.9	Jun 15 – Sep 15, 2001 Jun 15 – Sep 15, 2002	Johnson et al. (2004)
Kewaunee County	WI	20.5	6.4	Jul 1999 – Jul 2001	Howe et al. (2002)
Top of Iowa	IA	80.1	8.6	Apr 15 – Dec 15, 2003 Apr 15 – Dec 15, 2004	Jain (2005)
Cedar Ridge	WI	67.6	30.6	Mar 15 – May 31, Jul 15 – Nov 15, 2009	BHE (2011)
Cedar Ridge	WI	67.6	24.1	Mar 15 – May 31, Jul 15 – Nov 15, 2010	BHE (2011)
Crescent Ridge	IL	54.5	1.7	Sep – Nov 2005 August 2006	Kerlinger et al. (2007)
Blue Sky Green Field	WI	145	24.6	Jul 21 – Oct 31, 2008 Mar 15 – May 31, 2009	Gruver et al. (2009)
Forward Energy Center	WI	129.0	17.5	Jul 15 – Nov 15, 2008 Apr 15 – May 31, 2009 Jul 15 – Oct 15, 2009 Apr 15 – May 31, 2010	Grodsky and Drake (2011)
Fowler Ridge, Phases I, II, & III	IN	600.0	19.0	Apr 13 – May 15, 2010 Aug 1 – Oct 15, 2010	Good et al. (2011)
Fowler Ridge, Phases I, II, & III	IN	600.0	20.2	Apr 1 – May 15, 2011 Jul 15 – Oct 29, 2011	Good et al. (2012)
Rail Splitter	IL	100.5	11.5	May 17, 2012 – May 18, 2013	Good et al. (2013*a*)
Top Crop	IL	300.0	16.2	May 22, 2012 – May 16, 2013	Good et al. (2013*b*)
Big Blue	MN	36.0	2.0	Apr 1 – Dec 31, 2013	Fagen Engineering (2014)
Big Blue	MN	36.0	1.4	Mar 18 – Dec 31, 2014	Fagen Engineering (2015)

[1] Rates are from uncurtailed / unfeathered turbines (control treatment).

Effectiveness of Turbine Curtailment for Reducing Bat Mortality

Wind turbine blades can be feathered, i.e., pitched such that turbines spin very slowly or not at all, under certain weather conditions. Under normal operations, turbine blades usually remain pitched so that the turbine spins, or freewheels below "cut-in speed," the wind speed at which the turbines begin to generate electricity. Turbine curtailment refers to increasing cut-in speed and feathering turbines so they spin very slowly, or not at all below this increased cut-in speed. Studies conducted at wind projects in a variety of landscapes have demonstrated that curtailment effectively reduces bat mortality and that an inverse relationship exists between cut-in speed and bat mortality rates (Fiedler 2004, Kerns et al. 2005, Baerwald et al. 2009, Arnett et al. 2010, Good et al. 2011). A recent synthesis of publicly available curtailment studies reported at least a 50% reduction in bat fatalities when turbine cut-in speed was increased by 1.5 m/s above the manufacturer's cut-in speed (Arnett et al. 2013). Feathering below manufacturer's cut-in speed can reduce fatalities by 35 – 57.5% (Baerwald et al. 2009, Young et al. 2011, Good et al. 2012). Range and average percent reduction in mortality for different cut in speeds are presented in Table 4-6.

Table 4-6. Average reductions in bat mortality by cut-in speed from operational adjustment studies conducted in North America.

Cut-in speed	Range in percent reduction in mortality	Average percent reduction in mortality (number of studies)
4.0 m/s	34 – 58	46.0 (2)
4.5 m/s	72	--
5.0 m/s	50 – 87	66.8 (4)
6.5 m/s	74 – 79	76.3 (3)
6.9 m/s	82 – 95	88.3 (3)

Based on Baerwald et al. (2009), Arnett et al. (2011), Good et al. (2011, 2012), Young et al. (2011, 2012, 2013), Shoener Environmental (2013), Stantec (2015*b*), Tidhar et al. (2013).

Results of Post-construction Monitoring at the Hoopeston Wind Project

During the period from August 1 through October 15, 2015, the Project operated during nighttime hours (sunset to sunrise) when wind speeds were 6.9 m/s or higher. In accordance with their BBCS (Appendix A) and the Service's TAL (Appendix G), Hoopeston Wind conducted post construction avian and bat mortality monitoring from August 4 through October 15, 2015 and April 1 through May 15, 2016 (Ritzert et al. 2016). Monitoring and mortality estimation methods followed the protocols described in the BBCS (see Appendix A, Section 6.0).

In fall 2015, biologists collected 44 bat carcasses during scheduled searches. Bat carcasses identified included those belonging to eastern red bats (29), silver-haired bats (9), hoary bats (3), and big brown bats (3). The Project's fatality rates were based on carcasses found during scheduled searches. Table 4-7 provides a summary of the monitoring results for the fall 2015 period.

During the period from April 1 through July 31, all turbines were feathered at the manufacturer's rated cut-in speed (3.0 m/s). In spring 2016, biologists collected 3 silver-haired bat carcasses during scheduled searches. Table 4-8 provides a summary of the monitoring results for the spring 2016 period.

During the period from August 1 through October 15, 2016, turbines were feathered at a 5.0 m/s cut-in speed from sunset to sunrise. Biologists collected 20 bat carcasses during scheduled searches and 2 bat carcasses incidentally (Stantec 2017). Bat carcasses included eastern red bats (10), silver-haired bats (6), and hoary bats (6). Table 4-9 provides a summary of the monitoring results for the fall 2016 period. The estimated fatality rate was higher in fall 2016 under the lower cut-in speed as compared to the rate in fall 2015.

Table 4-7. Bat fatality estimates for turbines within the Hoopeston Wind Project from August 4 to October 14, 2015, using the Huso estimator.

	Fatality Estimate	**90% Confidence Interval**
Plot Type	***# fatalities/turbine/study period***	
Bats – Full Plot	1.37	0.46 - 2.71
Bats – Road/Pad	1.36	0.78 - 1.89
Bats - Overall	1.36	0.82 - 1.84
	# fatalities/MW/study period	
Bats – Full Plot	0.69	0.23 - 1.35
Bats – Road/Pad	0.68	0.39 - 0.94
Bats - Overall	0.68	0.41 - 0.92

Table 4-8. Bat fatality estimates for turbines within the Hoopeston Wind Project from April 1 through May 15, 2016, using the Huso estimator.

	Fatality Estimate	**90% Confidence Interval**
Plot Type	***# fatalities/turbine/study period***	
Bats – Full Plot	0.39	--
Bats – Road/Pad	n/a[1]	--
Bats - Overall	0.39	--
	# fatalities/MW/study period	
Bats – Full Plot	0.19	--
Bats – Road/Pad	n/a[1]	--
Bats - Overall	0.19	--

[1] No road/pad estimate could be calculated due to the low number of bats found on full plots during the spring, and no area correction factor could be calculated.

Table 4-9. Bat fatality estimates for turbines within the Hoopeston Wind Project from August 1 through October 15, 2016, using the estimator proposed by Erickson et al. (2003) as modified by Young et al. (2009).

	Full Plots	Roads and Pads
Observed bats/turbine/season	1.0	0.3
Probability of carcass availability and detection (90% CI)	5.0 (0.3, 0.7)	0.4 (0.2, 0.5)
Area adjustment	4.2	
Estimated bats/turbine/season (90% CI)	**4.3** (2.5, 8.3)	
Estimated bats/MW/season (90% CI)	**2.2** (1.3, 4.2)	
Estimated bats/facility/season (90% CI)	**211** (123, 407)	

Estimating Seasonal Bat Mortality

Based on the location of the Project, the fall migration period is from August 1 through October 15. We also expect that northern long-eared bats are most at risk of collision mortality during the fall migratory period, based on most of the fatalities documented occurring after July 31 (76%; Table 4-4) from those records for which we have dates.

Our analysis of bat mortality at the Project is largely based on the results from post-construction monitoring at Fowler Ridge. Fowler Ridge is relevant given its relatively close proximity (20 miles northeast of the Project), and the similarity in region, landscape, and land cover. It is reasonable to conclude that mortality patterns at Hoopeston Wind will be similar to Fowler Ridge. Also, the post-construction data from Fowler Ridge is a robust dataset compared to the two seasons of post-construction monitoring conducted at the Project.

We use the Applicant's methods for estimating take of Indiana bats and northern long-eared bats at the Project as explained in Section 6.4 of the Project HCP. To estimate a mortality rate for unlisted bats, we first examined mortality rates from Fowler Ridge during 2010 and 2011 at turbines where no minimization measures were implemented. To facilitate comparisons in bat mortality among the three alternatives, it is necessary to have 2 fatality rates for two reasons. First, it is generally accepted that bat mortality rates vary across the bat-active season (Kerns and Kerlinger 2004; Arnett et al. 2009, 2010, 2011; Jain et al. 2009, 2011; Good et al. 2012; Young et al. 2012). Second, under the Alternatives 1 and 2 turbines would be curtailed in the fall, making it necessary to use mortality rates from a combined spring/summer rate and a fall rate to account for bat mortality through the entire bat-active season.

To obtain a mortality rate **for the period outside of the fall curtailment period**, we used the data from 2011 at Fowler Ridge when monitoring included a summer period, which the 2010 monitoring did not (Good et al. 2012). We combined the spring (0.66 bats per turbine per year) and summer (2.90 bats per turbine per year) mean rates of adjusted mortality based on the empirical bias correction factor, which is **3.56 bats per turbine per season**. For the **fall mortality rate**, we elected to use the simple average of the empirical adjusted fatality estimates from the fall periods in both 2010 and 2011, which is **30.17 bats per turbine per season**. We first applied these rates to develop a baseline mortality rate for a project with no implemented minimization measures (turbine operational adjustments) that can then be used to facilitate calculating unlisted bat mortality across the 3 considered alternatives.

4.3.3.3 Habitat Impacts

Land use within the Project area is primarily active agriculture, and trees and forest are limited to narrow bands or clumps (Figure 3-2). Project construction did not require any tree clearing which would affect known roosts or potential roosts. Because the Project is already constructed, no impacts to roost habitat are anticipated for any alternative. Similarly, potential impacts to foraging habitat within the Project area are not anticipated and would be expected to be identical among alternatives. Similarly, alternatives are not expected to differ in their potential to cause habitat impacts during eventual repowering or decommissioning of the Project.

4.3.3.4 Direct and Indirect Effects Presented by Alternative

This section analyzes the potential effects to listed and unlisted bat species anticipated for each alternative. Table 4-10 summarizes the effects of each alternative and indicates the potential impacts unique to each alternative (italicized). Because the Project is already built, we did not include effects related to habitat loss. Table 4-11 and Table 4-12 summarize the estimated bat mortality annually for each alternative per turbine and per MW.

Table 4-10. Comparison of effects to bats for each alternative. Operational adjustments include feathering under all alternatives and all seasons with the exception of spring and summer operations under Alternative 1. [Note: Values were calculated and rounded using a spreadsheet application. Conducting straight calculations using the values shown will vary slightly due to rounding.]

	Annual Mortality		
Alternative and Operational Adjustment	**Indiana Bat**	**Northern Long-eared Bat**	**Unlisted Bats**
Alternative 1: No-Action (Take Avoidance) • Apr 1 – Jul 31 **3.0 m/s cut-in speed at 49 turbines (not feathered)** • Aug 1 – Oct 15 **6.9 m/s cut-in speed at 49 turbines**	• No spring / summer mortality expected • No fall mortality expected	• No spring / summer mortality expected • No fall mortality expected	• Spring / summer mortality **174** bats • Fall mortality **177** bats • Migratory tree-roosting species primarily affected • ***~88%** reduction in bat mortality during fall curtailed period* [1]

Alternative 2: Mixed Operations
• Apr 1 – Jul 31 **3.0 m/s cut-in speed at 49 turbines**
• Aug 1 – Oct 15
  ○ **5.0 m/s cut-in speed at 29 turbines** with temperature condition
  ○ **3.0 m/s cut-in speed at 20 turbines**
	• No spring / summer mortality expected
	• Fall mortality **1.57** bats
		• No spring / summer mortality expected
		• Fall mortality **1.85** bats
			• Spring / summer mortality **113** bats
			• Fall mortality **830** bats
			• Migratory tree-roosting species primarily affected
			• ***≥50%** reduction in bat mortality at curtailed turbines during fall migration period* [2]
			• ***≥35%** reduction in bat mortality at un-curtailed, feathered turbines for bat active season*

Alternative 3: Applicant's Proposal • Apr 1 – Oct 15 **3.0 m/s cut-in speed at 49 turbines**	• No spring / summer mortality expected • Fall mortality **2** Indiana bats	• No spring / summer mortality expected • Fall mortality **2** northern long-eared bats	• Spring / summer mortality **113** bats • Fall mortality **961** bats • Migratory tree-roosting species primarily affected • ***≥35%** reduction in bat mortality at uncurtailed, feathered turbines for bat-active season*

[1] Reduction in bat mortality averaged from 3 studies that operated turbines at 6.9 m/s cut-in speed: Beech Ridge (Tidhar et a. 2013; 88%), North Allegheny (Shoener Environmental 2013; 74-92%), and Pioneer Trail (ARCADIS 2013, 2014).

[2] Reduction in bat mortality assumed to be at least 50%, but likely higher, based on 4 studies that operated turbines at 5.0 m/s cut-in speed: Criterion (Young et al. 2013; 62%); Fowler Ridge (Good et al. 2011; 50%), and Casselman (Arnett et al. 2011; 87% and 68%).

Table 4-11. Listed bat mortality for each alternative per turbine and per MW.
[Note: Values were calculated and rounded using a spreadsheet application. Conducting straight calculations using values from this will differ slightly due to rounding.]

	Indiana Bat				Northern Long-eared Bat			
Alternative	Fall Rate per Turbine	Fall Rate per MW	Fall Mortality	Life of Project Mortality	Fall Rate per Turbine	Fall Rate per MW	Fall Mortality	Life of Project Mortality
1: No-Action	0	0	0	0	0	0	0	0
2: Mixed Operations (fall only)			1.57	47.1			1.85	55.5
5.0 m/s	0.029	0.014			0.034	0.017		
3.0 m/s	0.037	0.019			0.044	0.022		
3: Applicant's Proposal	0.041	0.020	2.00	60.0	0.041	0.020	2.00	60.0

Table 4-12. Unlisted bat mortality for each alternative per turbine and per MW.
[Note: Values were calculated and rounded using a spreadsheet application. Conducting straight calculations using values from this will differ due to rounding.]

	Spring/ Summer			Fall				
Alternative	Rate per Turbine	Rate per MW	Mortality	Rate per Turbine	Rate per MW	Mortality	Annual Mortality	Life of Project Mortality
1: No-Action	3.56	1.78	174	3.62	1.81	177	352	10,555
2: Mixed Operations (fall only)	2.31	1.16	113				943	28,292
5.0 m/s				15.08	7.54	437		
3.0 m/s				19.61	9.80	392		
3: Applicant's Proposal	2.31	1.16	113	19.61	9.81	961	1,074	32,229

Alternative 1: No-Action Alternative

Project Operations

Under Alternative 1, all 49 turbines would operate at 3.0 m/s in spring (no feathering) and feathered at 6.9 m/s in fall. The Service has concluded that feathering turbines fully when wind speeds are less than 6.9 m/s results in the unlikely risk of collision mortality for *Myotis* species, even if they are present in the area (USFWS 2012*d*). Therefore, we anticipate implementation of the No-Action Alternative is unlikely to take Indiana bats and northern long-eared bats.

During the spring and early summer period, we assumed unlisted bat mortality would be at the same rate observed at control turbines in spring at Fowler Ridge (3.56 bats per turbine). Based on the results of 3 post-construction studies (Tidhar et al. 2013, Shoener Environmental 2013, ARCADIS 2013, 2014), we estimate curtailing turbines below 6.9 m/s cut-in speed in the fall would reduce unlisted bat mortality by 88% at the Project. During the fall curtailment period (August 1 to October 15), we assumed unlisted bat mortality would be reduced from the predicted bat mortality rate of 30.17 bats per turbine to 3.62 bats per turbine (88% reduction). Under this alternative, we estimate the Project would kill 352 bats annually and approximately 10,555 bats over the 30-year life of the permit (Table 4-13). Table 4-13 compares mortality across alternatives for both listed and unlisted bats.

Table 4-13. Comparison of estimates of Indiana bat, northern long-eared bat, and unlisted bat mortality across alternatives.

		Alternative			
		1	2		3
Species	**Impact**	**No-Action**	**Mixed Operations**	**5.0 m/s Option**	**Applicant's Proposal**
Indiana bat	*Annual mortality*	0	1.57	1.40	2.00
	Permit period take (annual x 30 years)	0	47.1	42.0	60
	Take of females (75% of take)[1]	0	35.3	31.5	45
	Impact of the taking (lost female pups from every taken female) [1]	0	67.3	59.9	85.5
	Take to be mitigated (taken females + female pups)	0	102.6	91.4	130.5
Northern long-eared bat	*Annual mortality*	0	1.85	1.65	2.00
	Permit period take (annual x 30 years)	0	55.5	49.5	60.0
	Take of females (50% of take)	0	27.8	24.8	30.0
	Impact of the taking (lost female pups from every taken female) [1]	0	52.7	47.0	57.0
	Take to be mitigated (taken females + female pups)	0	80.5	71.8	87.0
Unlisted bats	*Annual mortality*	352	943	826	1,074
	Permit period mortality	10,555	28,292	24,792	32,229

[1] Using the REA Model for Indiana bats (USFWS 2013*b*) and assuming population to be stable.

Habitat Mitigation

The No-Action Alternative is not expected to result in take of listed bats. Habitat mitigation would not be required.

Alternative 2: Mixed Operations

Indiana Bat Take and Impact of the Taking

Indiana bat mortality is not expected to occur during maintenance, decommissioning, or mitigation activities. Project operation during the fall is the only activity expected to result in Indiana bat take.

For Alternative 2, our estimate for Indiana bat take is first based on the Applicant's average estimate of Indiana bat take presented in their proposed HCP (Alternative 3). The Applicant's method for estimating take of Indiana bats at the Project is explained in detail in Section 6.4.2 of the HCP. The Applicant estimated Indiana bat take using averages derived from three take estimation methods that relied on regional, national, and site-specific data. We used the average of 2.8 Indiana bats per year in the absence of the proposed minimization measures (0.057 bats per turbine per year) to estimate take for Alternative 2. Under Alternative 2, minimization measures include feathering all turbines in spring and summer (April 1 through July 31) at the manufacturer's rated cut-in speed (3.0 m/s). In the fall (August 1 through October 15), all turbines would be feathered at either of 2 cut-in speeds; 29 turbines at 5.0 m/s cut-in speed and 20 turbines at the manufacturer's rated cut-in speed of 3.0 m/s. This would result in 2 mortality rates depending on the minimization employed at that turbine, as shown in Table 4-11. For turbines with the 5.0 m/s cut-in speed, we predict the mortality rate would be reduced by 50% or greater (0.029 bats per turbine per season and 0.014 bats per MW per season). For turbines with the 3.0 m/s cut-in speed, the mortality rate would be reduced by at least 35% (0.037 bats per turbine per season and 0.019 bats per MW per season). Implementation of this operating regime would result in an annual take of 1.57 Indiana bats per year and 47.1 Indiana bats over the 30-year term of the ITP.

The Service has assumed more female Indiana bats than male Indiana bats will migrate through the Project area based on the distance between the Project area and the nearest hibernaculum (>100 miles). Evidence suggests female Indiana bats may occur more frequently than males as distances from hibernacula increase (USFWS 2012*e*). The Service estimates a 3:1 ratio of female to male Indiana bats migrating through the Project area each fall (USFWS 2012*e*). Consequently, approximately 75% of the 47.1 Indiana bats taken at the Project are expected to be female leading to an estimated take of 1.18 female bats per year or 35.5 female bats over the 30-year term of the ITP.

The loss of those 35.5 female bats is likely to result in lost reproductive potential in the population. Using the Service's Indiana bat REA Model for wind energy projects (USFWS 2013*b*), the impact module calculates debit as the sum of the female take (direct take) and the consequent loss in reproduction (total lost reproduction) over the life of the Project. In a population with a stationary growth rate (lambda condition), the REA Model assumes there will be 1.9 female pups lost for every 1 female taken. The impact of taking 35.5 female Indiana bats is likely to result in the further loss of 67.3 female pups. This impact results in a loss of 114.4 Indiana bats (47.1 bats killed + 67.3 female pups = 114.4 bats), which represents 0.04% of the estimated 2017 population of the OCRU (271,965 Indiana bats; USFWS 2017*a*). This take would be distributed over 30 years and mitigated by Hoopeston Wind as described in Section 7.2.2 of the Project HCP. The impact to be mitigated is the loss in female bats, i.e., 102.6 (35.3 females killed + 67.3 female pups).

Northern Long-eared Bat Take Limit and Impact of the Taking

Northern long-eared bat mortality is not expected to occur during maintenance, decommissioning, or mitigation activities. Project operation during the fall is the only activity expected to result in northern long-eared bat take.

For Alternative 2, northern long-eared bat take is first based on the Applicant's estimate take in the absence of operational minimization measures. As for Indiana bats, the Applicant's method for estimating take of northern long-eared bats at the Project is explained in detail in Section 6.4.2 of the Project HCP.

The Applicant estimated northern long-eared bat take using averages derived from three take estimation methods that relied on regional, national, and site-specific data. We used the average of 3.3 northern long-eared bats per year in the absence of the proposed minimization measures (0.067 bats per turbine per year) to estimate take for Alternative 2. Under Alternative 2, minimization measures include feathering all turbines in spring and summer (April 1 through July 31) at the manufacturer's rated cut-in speed (3.0 m/s). In the fall (August 1 through October 15), all turbines would be feathered at either of 2 cut-in speeds; 29 turbines at 5.0 m/s cut-in speed and 20 turbines at the manufacturer's rated cut-in speed of 3.0 m/s. This will result in 2 mortality rates depending on the minimization employed at that turbine, as shown in Table 4-11. For turbines with the 5.0 m/s cut-in speed, we predict the mortality rate for northern long-eared bats would be reduced by 50% (0.034 bats per turbine per season and 0.017 bats per MW per season). For turbines with the 3.0 m/s cut-in speed, the mortality rate would be reduced by at least 35% (0.044 bats per turbine per season and 0.022 bats per MW per season). Implementation of this operating regime would result in an annual take of 1.85 northern long-eared bats per year and 55.5 northern long-eared bats over the 30-year term of the ITP.

Section 6.4.3 in the Project HCP explains in detail how Hoopeston Wind has determined the impact of taking 60 northern long-eared bats. Unlike Indiana bats, northern long-eared bats show less dispersal from hibernacula (USFWS 2014), suggesting that females and males may be expected to migrate through the Project area in equal proportions. In summary, over the 30-year life of the Project, cumulative northern long-eared bat mortality includes taking 27.8 females, assuming a 1:1 ratio of male and female fatalities.

The impact of taking 27.8 females includes the estimated lost reproductive contribution of taken females. There is no REA Model for northern long-eared bats as there is for Indiana bats. If we assume the Service's REA Model for Indiana bats can be applied similarly to northern long-eared bats and the population is stable, there will be 1.9 female pups lost for every 1 female taken, i.e., 52.7 pups. The added impact of losing 52.7 female pups in the 30-year period results in 108.2 northern long-eared bats taken (55.5 fatalities + 52.7 lost female pups = 108.2 bats). This take would be distributed over 30 years and mitigated by Hoopeston Wind as described in Section 7.2.2 of the Project HCP.

Unlisted Bat Mortality

During the spring and early summer period, we assumed unlisted bat mortality would be 35% less than at Fowler Ridge due to feathering (2.31 bats per turbine). During the fall (August 1 to October 15), all turbines would be feathered at either of 2 cut-in speeds; 29 turbines at 5.0 m/s cut-in speed and 20 turbines at the manufacturer's rated cut-in speed of 3.0 m/s. This would result in 2 mortality rates depending on the minimization employed at that turbine, as shown in Table 4-12. Based on the results of 4 post-construction studies (Arnett et al. 2011, Good et al. 2011, Young et al. 2013), we estimate curtailing turbines below 5.0 m/s cut-in speed in the fall would reduce unlisted bat mortality by at least 50% at the Project (an average of reductions is closer to 67%; see Table 4-6). For turbines with the 5.0 m/s cut-in speed, we predict the mortality rate for unlisted bats would be 15.08 bats per turbine per season (7.54 bats per MW per season). For turbines with the 3.0 m/s cut-in speed, the mortality rate would be reduced by at least 35% (19.61 bats per turbine per season and 9.80 bats per MW per season). Implementation of this operating regime for the entire bat active season would result in an annual take of 943 unlisted bats per year and 28,292 bats over the 30-year term of the ITP (Table 4-12).

Habitat Mitigation

Under Alternative 2, Hoopeston Wind would implement measures to mitigate taking 102.6 female Indiana bats and 80.5 female northern long-eared bats over the 30-year term of the ITP. The Applicant's mitigation measures would be similar to those described for Alternative 3 but would be 117 acres as opposed to 165 acres.

Option Under Alternative 2: 5.0 m/s Cut-in Speed at all Turbines

Under Alternative 2, the Service has analyzed an option for Hoopeston Wind to implement an HCP that includes operational measures to reduce take of listed bats by employing a 5.0 m/s cut-in speed at all 49 turbines, from sunset to sunrise when the ambient temperature is above 10°C from August 1 through October 15. Under this 5.0 m/s option, Alternative 2 would be executed as described with only this modification to operational adjustments.

We used the average of 2.8 Indiana bats per year (0.057 bats per turbine per year) and 3.3 northern long-eared bats per year (0.067 bats per turbine per year) in the absence of the proposed minimization measures to estimate take for this option under Alternative 2. With the 5.0 m/s option under Alternative 2, Hoopeston Wind would achieve at least 50% reduction in all bat mortality at all 49 turbines. Assuming listed bats would experience this same reduction in mortality, this translates to taking 1.40 Indiana bats and 1.65 northern long-eared bats per year. Over the 30-year permit term, the Project would thus be predicted to kill roughly 42 Indiana bats and 50 northern long-eared bats.

For unlisted bats, the 5.0 m/s option would be predicted to kill 853 unlisted bats, 113 bats in spring and 739 bats in the fall. This option would result in slightly less mortality than that predicted for the mixed operations.

Alternative 3: Applicant's Proposal

Proposed Indiana Bat Take Limit and Impact of the Taking

The Applicant's method for estimating take of Indiana bats at the Project is explained in detail in Section 6.4.2 of the HCP. Indiana bat mortality is not expected to occur during maintenance, decommissioning, or mitigation activities. Project operation is the only activity expected to result in Indiana bat take.

As stated previously, the Applicant derived an average mortality rate of 2.8 Indiana bats per year using data from Fowler Ridge (Good et al. 2011, 2012) and synthesized data from Arnett and Baerwald (2013). The Applicant is proposing to use an intermediate value of estimated take of 2 Indiana bats per year in the absence of the proposed minimization measures. Implementing the proposed minimization measures, i.e., feathering all turbines at the manufacturer's rated cut-in speed of 3.0 m/s, Hoopeston Wind predicts this will reduce Indiana bat fatalities by 35%, bringing the annual take to 1.3 Indiana bats per year. For the purposes of the requested ITP, Hoopeston Wind is applying for a take limit of 2 Indiana bats per year, despite the estimated reduced risk to bats from feathering below manufacturer's rated cut-in speed. This will result in a total of 60 Indiana bats over the 30-year term of the ITP.

Section 6.4.3 in the Project HCP explains in detail how Hoopeston Wind has determined the impact of taking 60 Indiana bats and follows the rationale explained above under Alternative 2. Thus, the total number of Indiana bats expected to be removed from the population over the 30-year permit term includes the take estimate (60 Indiana bats) as well as the lost reproductive contribution of the 45 female bats lost, which is 85.5 female pups (based on 1.9 female pups/bat), resulting in 145.5 Indiana bats. This represents 0.05% of the estimated 2017 population of the OCRU (271,965 Indiana bats; USFWS 2017*a*), in which the Project is located. This take will be distributed over 30 years and mitigated by Hoopeston Wind as described in Section 7.2.2 of the Project HCP.

Proposed Northern Long-eared Bat Take Limit and Impact of the Taking

As for Indiana bats, the Applicant's method for estimating take of northern long-eared bats at the Project is explained in detail in Section 6.4.2 of the Project HCP. Northern long-eared bat mortality is not expected to occur during maintenance, decommissioning, or mitigation activities. Project operation is the only activity expected to result in take of northern long-eared bats.

As stated above, the Applicant used mortality data from Fowler Ridge (Good et al. 2011, 2012) and synthesized data from Arnett and Baerwald (2013) to derive an average take estimate of 3.3 northern long-eared bats per year. The Applicant is proposing to use an intermediate value of estimated take of 3 northern long-eared bats per year in the absence of the minimization measures. Implementing the proposed minimization measures, feathering all turbines at the manufacturer's rated cut-in speed of 3.0 m/s, Hoopeston Wind predicts this will reduce northern long-eared bat fatalities by 35%, bringing the annual take to 1.9 northern long-eared bats per year. For the purposes of the requested ITP, Hoopeston Wind is applying for a take limit of 2 northern long-eared bats per year. This will result in taking 60 northern long-eared bats over the 30-year term of the ITP.

As explained above, northern long-eared bat mortality is expected to comprise an even distribution of male and female fatalities, assuming a 1:1 ratio of male and female dispersal in the landscape. The impact of taking 30 females includes the estimated lost reproductive contribution of taken females. Again, if we assume the Service's REA Model for Indiana bats can be applied similarly to northern long-eared bats and the population is stable, there will be 1.9 female pups lost for every 1 female taken, i.e., 57 pups. The added impact of losing 57 female pups in the 30-year period results in 117 northern long-eared bats taken

(60 fatalities + 57 lost female pups = 117 bats). This take will be distributed over 30 years and mitigated by Hoopeston Wind as described in Section 7.2.2 of the Project HCP.

Unlisted Bat Mortality

Based on results of available curtailment studies, the Project HCP estimates that feathering turbines blades below a cut-in speed of 3.0 m/s during the bat-active season (April 1 through October 15) will reduce all bat mortality, as well as Indiana and northern long-eared bat mortality, by at least 35%. Based on this percentage, estimates for spring and summer mortality rates change from 3.56 bats per turbine per season to 2.31 bats per turbine per season (1.16 bats per MW per season). Similarly, estimates for fall mortality rates change from 30.17 bats per turbine per season to 19.61 bats per turbine per season (9.80 bats per MW per season). Under Alternative 3, mortality of unlisted bats will be approximately 1,074 for each bat-active season and 32,229 for the 30-year life of the permit. These estimates include Project-related mortality alone and do not attempt to account for lost reproductive potential.

Habitat Mitigation

To mitigate the unavoidable take and the impact of the taking of female Indiana bats and northern long-eared bats, Hoopeston Wind proposes to fund the restoration and/or enhancement of forested bat habitat. The specific mitigation plan will be developed and approved by the Service within five months of permit issuance. The goal of the mitigation project is to support recovery plan-based conservation projects on no less than 165 acres of land for Covered Species within Illinois, in the Embarras River Watershed or other occupied watershed in proximity to the Hoopeston Wind Project. Also, the mitigation plan will comply with the objectives identified in Section 7.2.2 of the HCP and follow the Mitigation Project Criteria (Appendix B) of the HCP.

If mitigation measures include protecting forested habitat already known to support listed bat maternity colonies, other bat species that roost or forage in the landscape will also benefit. Eastern Illinois is dominated by agricultural land use, and creation and protection of forested habitat will improve the habitat diversity of the area and benefit all resident bats by increasing the extent and diversity of roosting and foraging habitat. Additional forest habitat in the region will also presumably provide stopover habitat for long-distance migratory species.

4.3.3.5 Summary of Effects to Bat Resources

Table 4-13 provides a summary of mortality estimates under each alternative.

The Service predicts that the implementation of the No-Action Alternative is not likely to result in take of Indiana bats, northern long-eared bats, or any other *Myotis* species. Under the No-Action Alternative, the Service assumes the Project will kill unlisted bats but at a significantly reduced rate than in the absence of any minimization measure.

Under Alternative 3, the Applicant estimates the Project will result in the eventual loss of 145.5 Indiana bats, which represents 0.05% of the estimated 2015 population of the OCRU (243,142 Indiana bats) and will be distributed over 30 years. Considering the overall low level of expected take and the measures Hoopeston Wind will implement to compensate for the take, the Service finds the Project will not significantly affect this species. Under Alternative 2, take of Indiana bats is estimated to be lower than Alternative 3 (Table 4-13), and the Applicant would be required to provide less mitigation for covered species.

Under Alternatives 2 and 3, the Applicant would fully mitigate for the impact of the taking of Indiana bats and northern long-eared bats summer habitat protection or restoration as described in Section 7.2.2 of the Project HCP.

Under Alternative 3, the Applicant estimates the Project will result in the eventual loss of 117 northern long-eared bats, which represents 0.004% of the Midwest population (2,785,032), and this loss will be distributed over 30 years. Considering the overall low level of expected take and the measures Hoopeston Wind will implement to compensate for the take, the Service finds the Project is unlikely to significantly affect this species. Under Alternative 2, take of Indiana bats and northern long-eared bats would be slightly lower than Alternative 3 (Table 4-13).

Under Alternative 3, the Service estimates the Project will kill more than 1,000 unlisted bats annually and more than 30,000 unlisted bats over the 30-year life of the Project. We estimate that unlisted bat mortality will be slightly lower under Alternative 2 (28,292) and significantly lower under Alternative 1 (10,555). Knowledge of populations is necessary to understand the implications of bat mortality. Unfortunately, we currently have little information to inform current population estimates for most bat species in North America at local, regional, or continental scales (O'Shea et al. 2003, Kunz et al. 2007*a*). Hence, there is insufficient information to understand the population-level effects associated with this level of mortality, particularly for long-distance migratory bat species.

Under the Applicant's Proposal (Alternative 3), bat mortality will be reduced by 35% or more over due to the curtailment strategy as compared to mortality estimated in the absence of any operational adjustments. Under Alternative 2, bat mortality is expected to be reduced as compared to Alternative 3; however, Alternative 2 would result in lost generation and potentially greater GHG emissions compared to Alternative 3. Both Alternative 2 and Alternative 3 would include mitigation to offset mortality to Indiana bats and northern long-eared bats and may benefit other cave-dwelling bats.

Alternative 2's mixed operations strategy would provide an opportunity to evaluate curtailment specific to the Project. Under Alternative 3, the 3.0 m/s feathering strategy in fall can be compared to two previous fall seasons when the Project turbines were feathered at 6.9 m/s cut-in speed. Both alternatives would employ a robust fatality monitoring regime to estimate take of covered species. Under Alternative 2 or 3, if the objective of the operational adjustment is not met (i.e., authorized take is likely to be exceeded), further operational adjustments would be made as part of the adaptive management responses for covered species.

4.4 SOCIOECONOMIC ENVIRONMENT

4.4.1 Economics

Pursuant to NEPA, effects to the human environment include those to socioeconomic conditions (40 CFR 1508.14). This section of the EA describes the effects of the three alternatives under consideration on socioeconomic conditions of Illinois, Vermilion County, and the city of Hoopeston. Current socioeconomic conditions are described in Section 3.4.1.

This section addresses effects to economics associated with Project operations. We do not anticipate that the bat habitat mitigation projects will have significant effects to social or economic conditions in the region.

4.4.1.1 Impact Criteria

Effects would be considered significant if any of the following occurred as a result of implementing any of the three alternatives:

1) Decline in local or regional employment;
2) Decrease in local or regional property values;
3) Decline in valuable community services; or

4) Disproportionate share of adverse environmental effects placed on any minority or low-income community.

4.4.1.2 Direct and Indirect Effects

Project Operations and Maintenance

Implementation of any of the three alternatives would likely have the same effect, if any, on property values. Losses in property values in those lands in and surrounding the Project have not been documented. For 1 Project in Illinois, Hinman (2010) found an initial stigma associated with wind farms may have caused property values to diminish during the proposal and planning stage. However, property values rebounded and some increased around the facility once constructed. Similarly, Hoen et al. (2009) looked at data from roughly 7,500 homes situated within 10 miles of wind facilities and found no conclusive evidence of any widespread property value impacts in these communities. Specifically, Hoen et al. (2009) found no consistent, measurable, or statistically significant effect on home sales prices relative to the view of a wind facility or the distance of the home to the facility. Vyn and McCullough (2014) suggest wind turbines at 1 of Ontario, Canada's oldest wind projects have not significantly impacted nearby property values.

Implementation of any alternative is not expected to result in reduced valuation in properties in and proximal to the Project area. No minority or low-income communities would be disproportionately affected by Project operations under any of the three alternatives.

Implementation of any of the three alternatives would result in ~$15-21 million in property taxes paid to Vermilion County over the 25-year life of the Project. Implementation of any of the three alternatives would result in similar benefits to those community services that receive funding derived from taxes paid by Hoopeston Wind. The education systems in both counties are the principle beneficiary of funds derived from the Project.

Additional personal income is generated for residents in the local area and the state through circulation and recirculation of dollars in the form of the Applicant's as business expenditures and state and local taxes. Expenditures made for equipment, energy, fuel, operating supplies, and other products and services benefit businesses in Hoopeston, Rossville, Vermilion County, and Illinois.

Implementation of any of the three alternatives is not expected to affect community services such as water and wastewater services. Any of the three alternatives would have the same effect on those community-based services that derive funding from the tax revenue provided by the Project. Project operation and maintenance would not cause additional impacts on leading industries within the Project area. None of the three alternatives would indirectly affect those community-based services that derive funding from the tax revenue provided by the Project. Property taxes and the number of permanent jobs would not be affected.

Landowners with turbines receive royalty payments, which are in part based on the actual energy generation of the turbine on their land. As production is reduced, the landowner receives less income down to a minimum value. Energy production would be highest under Alternative 3, the 3.0 m/s alternative, followed logically by Alternative 2, the mixed operations, and No-Action alternative. Insufficient data exist to characterize the extent of the effect that restricted operations under any individual alternative would have on royalty payments to the landowners.

Impacts associated with maintaining the Project will not vary among the three alternatives. The Project is expected to need the same level of maintenance in the event or absence of operational restrictions. Effects to socioeconomic conditions from Project maintenance will not vary among alternatives. The Project employs 9 permanent staff to monitor and maintain the site and 2 seasonal jobs to conduct mortality monitoring.

Decommissioning Effects

There is little information on the effects to economic conditions associated with decommissioning large, commercial-scale wind farms. In the eastern U.S., older wind projects are only now approaching the decommissioning or re-powering stage. Impacts associated with decommissioning will not vary among the three alternatives, and Hoopeston Wind's decommissioning plan will be implemented regardless of the Project's operational regime. Implementation of any alternative is expected to require the same level of effort for decommissioning. During this stage, the added temporary labor force would have benefits to state and local economies. Total wages and salaries paid to contractors and workers would increase temporarily and contribute to the total personal income in the region. Additional personal income will be generated for residents in the local area and the state through circulation and recirculation of dollars derived from the burst in decommissioning activities. Expenditures made for equipment, energy, fuel, operating supplies, and other products and services will benefit businesses in Hoopeston, Rossville, Vermilion County, and Illinois.

4.4.1.3 Summary of Effects to the Socioeconomic Environment

We do not anticipate there will be adverse effects to the socioeconomic conditions at the state or local levels as a result of any of the three alternatives under consideration. A disproportionate share of adverse environmental effects resulting from operation, maintenance, and decommissioning the Project would not be placed on any minority or low-income community. No specific mitigation measures for socioeconomics or environmental justice would be implemented under any of the three alternatives.

4.5 CUMULATIVE EFFECTS

The CEQ guidelines acknowledge "in a broad sense all the impacts on affected resources are probably cumulative." Nonetheless, it is important to "count what counts" and narrow the focus of the analysis to important national, regional, and local issues (CEQ 1997). The CEQ recommends the NEPA analysis should include those potential cumulative effects with direct influence on the agency's action and decision-making. Thus, as per the CEQ guidelines (CEQ 1997), resources that would not be impacted by the proposed action or action alternatives, have beneficial effects, or are only subject to temporary effects were excluded from this analysis.

Following the tiered approach recommended by the CEQ guidelines for analyzing cumulative effects, we focus our analysis on potential impacts to birds, Indiana bats, northern long-eared bats, and unlisted bats, as these are the only resources on which Project operations will have potentially adverse effects. Furthermore, only bats will be affected to varying degrees by the alternatives considered in this EA as we have assumed operational adjustments do not affect bird mortality. Similarly, this analysis largely focuses on cumulative effects of current, proposed, and projected wind energy development on birds and bats. We also analyze impacts associated with WNS for bats and other mortality sources for birds.

For decades, researchers have monitored bird mortality to some degree at other sources, such as communications towers and other tall structures. However, both wind energy development and WNS have emerged as new but substantial sources of bat mortality in the past decade. While some level of bat mortality likely went unnoticed at wind projects previously, the rapid expansion of wind development and the increased awareness of bat mortality at wind turbines have revealed the potential for substantial cumulative impacts to bats from the wind industry.

This section analyzes cumulative effects of the alternatives and other past, current, proposed, or reasonably foreseeable future actions on birds, Indiana bats, northern long-eared bats, and unlisted bats. The spatial scope of analysis for Indiana bats is the OCRU, and for birds, northern long-eared bats, and unlisted bats, it is the Service's Region 3. The 30-year permit duration is the temporal scope for all animal resources.

4.5.1 Wind Energy Development

According to 2015 data compiled by the American Wind Energy Association (AWEA 2015), 12,798 turbines totaling 17,405 MW are currently installed in the 8 states that make up USFWS Region 3 (Table 4-14). While growth in the wind sector has been rapid over the previous few years, the U.S. Energy Information Administration's energy forecasts indicated a nationwide growth rate of 2.2% annually for installed wind energy capacity between 2012 and 2040 (USEIA 2015). Applying this growth rate to installed and proposed capacity in the states in Region 3 over the 30-year permit duration, we estimate a total capacity of 35,859 MW in the Region by year 2046. Assuming that turbine size averages around 1.6 MW, this translates to 22,412 turbines installed. We estimated wind energy development in the OCRU by adding the estimates for Illinois, Missouri, and Iowa (Table 4-14). The OCRU includes the northern third of Arkansas and eastern edge of Oklahoma. There is one operating wind turbine in Arkansas, and no new projects are under construction. Oklahoma has 5,453 MW of installed capacity and 2,915 turbines, but these projects are located in the western half of the state (AWEA 2015). Therefore, we did not include wind energy resources in Arkansas and Oklahoma as part of our cumulative effects analysis.

Table 4-14. Installed and projected wind energy development in Service Region 3 and OCRU.

	Current Installed [1]		Projected growth up to 2046 (30 years) [2]	
State	*# MW*	*# Turbines*	*# MW*	*# Turbines* [3]
Illinois	3,842	2,348	7,543	4,714
Wisconsin	648	417	1,272	795
Michigan	1,531	887	3,006	1,879
Minnesota	3,235	2,257	6,351	3,969
Iowa	6,212	3,658	12,196	7,622
Missouri	459	252	901	563
Indiana	1,895	1,096	3,720	2,325
Ohio	443	253	870	544
Region 3 Total	18,265	11,168	35,859	22,412
OCRU Total [4]	10,513	6,258	20,640	12,900

[1] From state fact sheets at AWEA.org showing installed capacity as of the end of 2015, accessed March 4, 2016.
[2] Assuming 2.2% annual growth, the nationwide trend estimated for net summer capacity for wind energy from 2015 to 2046 (USEIA 2015).
[3] Assuming 1.6-MW turbines; MW divided by 1.6.
[4] OCRU total based on sums from Illinois, Iowa, and Missouri. Hence growth projections only include estimates from Illinois, Iowa, and Missouri.

Currently, the OCRU includes approximately 6,258 turbines and 10,513 MW of installed capacity (Table 4-14). Applying the same 2.2% annual growth rate to the installed capacity in the OCRU yields an estimate of 12,900 turbines and 20,640 MW of installed capacity by year 2046. We recognize that wind development, realistically, is likely to vary among states. Also, we derived these estimates using only one method among several that could be implemented. Nonetheless, our method represents a straightforward means of estimating reasonably foreseeable wind energy development in Region 3 and the OCRU.

4.5.2 Birds

Our cumulative effects analysis for birds primarily focuses on mortality attributable to the Project in the context of other existing and future wind facilities in Region 3. This analysis also considers other known anthropogenic sources of bird mortality. We briefly discuss on a national scale those elements that are known to cause avian mortality. Researchers typically use data at the national scale to provide estimates of bird mortality from an anthropogenic source.

This analysis includes past and present actions and reasonably foreseeable future sources of impacts to birds during the 30-year operation of the Project. Based on our analysis of direct and indirect effects to avian resources in Section 4.3.2.2, the Project has the potential to kill, disturb, and displace birds due to Project presence and operations. We recognize that birds are likely to sustain these same effects at all wind projects in Region 3.

4.5.2.1 Wind Project Mortality

Given the proximity to the Hoopeston Wind Project, it is reasonable to predict that the Project will have in most years a mortality rate similar to that observed at Fowler Ridge, 5.26 birds per turbine per year or 2.63 birds per MW per year. This will result in roughly 258 bird fatalities per year of which roughly 70% will be passerines. This is roughly 0.4% of the total bird mortality from installed wind projects in Region 3. Based on a mortality rate of 5.26 birds per turbine per year, over the permit term the Project will kill approximately 7,700 birds. This is roughly 0.3% of the total bird mortality estimated to occur at installed wind projects in Region 3 through 2046. Table 4-15 shows a summary of estimated bird mortality of the Project and other wind projects in Region 3 from 2016 to 2046.

Table 4-15. Cumulative bird mortality estimates at Hoopeston Wind Project and current and projected installed wind power capacity in the Service's Region 3.

[Note: Values were calculated and rounded using a spreadsheet application. Conducting straight calculations using values from this will differ due to rounding.]

		Project		Region 3				
		Annual mortality	30-year cumulative mortality	Annual mortality in 2016	Project % contribution to annual	Annual mortality in 2046	30-year cumulative mortality	Project % contribution to Region
No. turbines		49	49	11,168	49	22,412	11,168-22,412	49
Mortality rate (birds per turbine per year)		Bird mortality		Bird mortality				
Minimum	0.33	16	485	3,850	0.4	7,396	~169,000	0.3
Maximum	11.83	580	17,390	138,018	0.4	65,132	~6 million	0.3
Regional Rate	3.59	--	--	41,884	--	80,458	~1.8 million	--
Project Rate	5.26	258	7,732	--	0.4	258	7,732	0.3

[1] Based on 2.2% annual growth (USEIA 2015) from 2015 installed capacity.
[2] Based on a projected annual growth of 2.2% a year (USEIA 2015).

Based on results from post-construction studies conducted at 9 wind power projects in the Midwest (see Table F-1 in Appendix F), bird mortality rates ranged from 0.33 to 11.83 birds per turbine per year and averaged 3.59 birds per turbine per year. We applied the regional rate of 3.59 birds per turbine per year to the current installed capacity of wind projects in Region 3, 11,168 turbines. As discussed, bird mortality at the Project is expected to be the same regardless of the alternative under which the Project operates, roughly 258 birds per year. Therefore, Hoopeston Wind will contribute 0.4% of the annual bird mortality from wind projects in Region 3.

The rate at which wind energy will develop over the next 30 years is difficult to predict, but we assumed the 2.2% growth estimated in USEIA (2015). Based on the maximum rate of bird mortality (11.83 birds per turbine per year), wind projects in Region 3 may kill more than 6 million birds over the permit term, averaging approximately 195,000 birds per year. This illustrates a worst-case scenario, and it is possible that some years may exhibit such high mortality rates. However, we expect to see in most years rates closer to 3.59 birds per turbine per year, and cumulative bird mortality is likely to be closer to 1.8 million birds in Region 3.

In Appendix D, Table D-1 lists bird species and numbers documented during post-construction monitoring at projects in the Midwest. This list includes 5 Birds of Conservation Concern for Bird Conservation Region 22 (USFWS 2008), where the Project is located. Carcass searches during the monitoring at these wind projects found 2 pied-billed grebes, 2 grasshopper sparrows, 1 upland sandpiper, 1 black-billed cuckoo, and 1 loggerhead shrike out of the total 283 birds, a combined total over several years. We do not expect that wind projects in Region 3 will cause population-level effects to avian resources, even those species of regional concern.

4.5.2.1 Anthropogenic Sources of Avian Mortality Other than Wind Power Facilities

Discussed below are estimates of anthropogenic sources of bird mortality for the U.S. in general. Table 4-16 provides annual mortality levels of birds due to anthropogenic sources in the U.S. We recognize that the national level is not the cumulative effects analysis area selected for birds in this EA. However, similar data scaled to any region of the U.S. are not available.

Table 4-16. Estimated annual avian mortality from anthropogenic causes in the U.S.

Mortality source	Estimated annual mortality	% of overall mortality
Depredation by domestic cats	1.3–4.0 billion	71-75
Collisions with buildings (including windows)	97-1,200 million	5-23
Collisions with power lines	130-174 million	3-7
Legal harvest	120 million	6
Automobiles	50-100 million	2-3
Pesticides	67 -72 million	4
Communication towers	4-50 million	<1
Oil pits	1.5-2 million	<1
Wind turbines	20,000-440,000	<1
Total mortality	1.9-5.2 billion	

Sources: USFWS (2002), Erickson et al. (2005), Thogmartin et al. (2006), Dauphiné and Cooper (2009), Manville (2009), Loss et al. (2013).

Communication Towers

Avian collisions with communication towers in the U.S. present a significant source of annual mortality, particularly for nocturnally migrating songbirds; namely warblers, vireos, and thrushes (Erickson et al. 2005). Erickson et al. (2005) suggest the number of communication towers in the U.S. may be as high as 200,000 towers; and that 5,000 to 10,000 new towers are being built each year. Cellular, radio, and television towers range in height from less than 100 feet to over 2,000 feet (Kerlinger 2000). Mortality estimates range from 4-5 million to 40-50 million birds per year in the U.S. and involve over 230 species

(Kerlinger 2000, Shire et al. 2000, Erickson et al. 2005, Manville 2005, Thogmartin et al. 2006). Collisions occur throughout the year but are most frequent during migration periods. Studies indicate fatality rates are highest at taller, guyed towers (Gehring et al. 2009, 2011). Data associate higher collision rates at pulsating beacons and steady burning FAA obstruction lighting as compared to towers lit only with flashing or white-strobe beacons (Erickson et al. 2005, Gehring et al. 2009, 2011). During nights with fog or low, cloud-ceiling heights, researchers believe nocturnal migrants become disoriented by strobe or steady burning lights on towers (Erickson et al. 2005). Estimates of mean annual collisions per tower have ranged from 82 birds per year at a 250-meter (825 feet) tower in Alabama, to 3,199 birds per year at a 305-meter (1,000-foot) tower in Wisconsin (Erickson et al. 2005).

Buildings

USEIA (2008) estimates there were 4.9 million commercial buildings in 2003. More than 130 million residential housing units existed in the U.S. in 2009 (U.S. Census Bureau 2011). Estimates of collisions with buildings and windows suggest a range of 97 million to 1,200 million bird deaths per year (Erickson et al. 2005, Thogmartin et al. 2006). Loss et al. (2014) estimate that between 365 and 988 million birds (median 599 million) are killed annually by building collisions in the U.S. The vast majority of avian collisions with buildings and windows involve passerines (Erickson et al. 2005). A study conducted in 1996 in Toronto, Ontario estimated 733 avian fatalities per building per year (Erickson et al. 2005). A study of avian collisions with residential windows indicated that avian fatalities range from 0.65 to 7.7 birds per house per year (Erickson et al. 2005). Collisions with other tall structures such as smoke stacks are estimated to result in tens to hundreds of thousands of collisions.

Power Lines

Manville (2005) estimated that there are collectively 500,000 miles of transmission lines in the U.S. There is an estimate of 116,531,289 distribution poles in the U.S. An accurate estimate of the collective distance of distribution lines is not feasible, but Manville (2005) suggests the length may be in the millions of miles. In general, avian collision and electrocution mortality at power transmission and distribution lines are not systematically monitored or subject to observational biases. Collision estimates range from hundreds of thousands to 175 million birds annually, and estimates of electrocutions range from tens to hundreds of thousands of birds annually. Raptors, particularly eagles, are most commonly reported for collision or electrocution with transmission or distribution lines in the U.S. (Manville 2005).

The species composition of birds involved in power line collisions is largely dependent on location. For example, power lines located in wetlands have resulted in collisions of mainly waterfowl and shorebirds; while power lines located in uplands and away from wetlands have resulted in collisions of mainly raptors and passerines (Erickson et al. 2005, Manville 2005).

Legal Harvest

Banks (1979 as cited by Thogmartin et al. 2006) estimated hunters legally harvest 120 million waterfowl and game birds each year in the U.S. State and federal wildlife managers census waterfowl and monitor harvests annually. These data are used to regulate harvest levels through bag limits such that hunting does not contribute to population declines.

Vehicles and Airplanes

Vehicle strikes are estimated to result in 50 million to 100 million avian fatalities per year (Thogmartin et al. 2006). Numbers and species involved in vehicle collisions are dependent on habitat and geographical location (Erickson et al. 2005). Including both United States Air Force and civil aircraft strikes, it is estimated that over 28,500 avian collisions occur each year (Erickson et al. 2005). Species typically involved in airplane strikes include gulls, waterfowl, and raptors (Erickson et al. 2005).

Pesticides

The USDA 2007 Census of Agriculture (USDA 2009) indicates there were approximately 406.5 million acres of cropland in the U.S. Pesticides are used on the vast majority of U.S. cropland. Table 4-17 lists acres of agricultural lands treated with chemicals in 2007. These values are based on the agricultural census and do not include those acres treated with pesticides associated with other commercial uses (e.g., utility corridors, forest management, golf courses) or residential use. Piemental et al. (1991 as cited by USFWS 2002 and Erickson et al. 2005) estimate 67.2 million birds die from exposure to pesticides in the U.S. annually. Other estimates indicate 72 million pesticide-related avian fatalities per year (USFWS 2002). One study indicated that there are 0.1 to 3.6 avian fatalities per acre of pesticide-treated cropland (Mineau 1988 as cited by Erickson et al. 2005).

Table 4-17. Acres of agricultural lands treated with chemicals in the U.S. in 2007 by targeted pest.

Pest Type:	Acres
Insects	90,947,822
Weeds, grass, brush	226,295,783
Nematodes	7,560,158
Diseases	22,693,212
Growth, fruit production, or defoliation	12,125,799

Source: USDA 2009

Domestic Cats

Dauphiné and Cooper (2009) estimate that 117 to 157 million feral and free-ranging domestic cats within the U.S. kill at least 1 billion birds annually. Loss et al. (2013) estimate that free-ranging domestic cats kill 1.4 to 3.7 billion birds annually in the U.S. Based on these estimates and others (Manville 2005, Erickson et al. 2005), cat predation is considered the most significant anthropogenic source of bird mortality in the U.S. (Dauphiné and Cooper 2011). Butchart et al. (2006) cited domestic cats as significant threats to rare, threatened, and endangered birds and sources of species extinction worldwide.

4.5.2.2 Other Cumulative Effects to Birds in Region 3

Habitat Loss and Displacement

In Region 3, avian resources have experienced impacts due to land conversion (habitat loss) associated with oil and gas development, urbanization, agriculture, and residential development. All these activities are likely to continue into the reasonably foreseeable future. Most of these land conversion activities often include extensive road networks.

Agriculture activities, urbanization, and residential development convert habitat for the length of time that the development is maintained. Development that results in pavement (asphalt, concrete) results in an extreme conversion of habitat with a very slow recovery rate unless pavement is removed. Conversely, some active agricultural lands may become inactive and revert to native habitats within the 30-year permit term.

Reasonably foreseeable future actions in the Project area for the next 30 years that will affect avian resources include low-density development for residences. This will largely affect those birds that are likely to use agriculture lands.

4.5.2.3 Cumulative Effects Summary

We acknowledge that bird mortality at wind projects does contribute to overall mortality. Compared to other anthropogenic sources of avian mortality (see Table 4-16), the effect of avian mortality at wind energy facilities is minor.

None of the alternatives considered is expected to cause naturally occurring populations of common birds to be reduced to numbers below levels for maintaining viability at local or regional levels. The alternatives will not result in substantial losses or degradation of habitat for a rare, threatened, or endangered animal species. None of the alternatives is expected to result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The conversion of approximately 50 acres of agricultural land to developed land cannot be considered a major loss of this habitat type given the Project is located in a landscape dominated by extensive agriculture.

Project mortality will contribute cumulatively to other sources of mortality, such as other wind projects. Species with high collision rates that are already compromised by other factors and exhibiting decreasing trends will be affected more than common species with secure populations, yet the effect is currently predicted to amount to a fraction of a percent of any population of a bird species of conservation concern. These small percentages of wind power mortality contribute a relatively minor cumulative effect to many other sizeable sources of human-caused bird mortality. The small percentage contribution from wind power does not diminish the need to reduce sizeable sources of bird mortality when practicable.

The BBCS for all alternatives includes a monitoring plan and adaptive management framework designed to monitor bird mortality and respond to significant bird mortality events should they occur.

4.5.3 Bats

4.5.3.1 Wind Project Mortality

Indiana Bats

No Indiana bat fatalities have been documented at wind projects in the OCRU. Of the 7 Indiana bat fatalities that occurred, 5 of these fatalities occurred in fall, 1 in summer, and 1 in spring (Table 4-3). These have occurred in the Midwest Recovery Unit (including a location on the border of the OCRU and Midwest Recovery Unit), and in the Appalachian Mountains Recovery Unit. Currently, it is the Service's position that any wind project within the OCRU has the potential to take an Indiana bat during the fall migratory season when turbines are operating at <6.9 m/s cut-in speed. Based on two documented fatalities at Fowler Ridge and 2 years of monitoring, Fowler Ridge (2013) derived a baseline mortality estimate of 0.05 Indiana bats per turbine per year (90% CI = 0.04 – 0.06 bats/turbine/year) in the absence of minimization measures. Applying this same estimate to the current installed wind energy capacity in the OCRU (6,258 turbines) yields 336 Indiana bats taken per year by wind projects within the OCRU. By year 2046, the annual take estimate will be 645 Indiana bats based on the projected wind development indicated in Table 4-14. This represents 0.24% of the 2017 Indiana bat population in the OCRU (271,965; USFWS 2017*a*). Summing the mortality over the permit duration results in approximately 15,000 Indiana bats taken by wind projects cumulatively in the OCRU over the next 30 years (Table 4-18). This estimate assumes that wind projects in the OCRU will implement no operational curtailment, which is currently not the case and not likely to be the case in the future. However, this represents a worst-case scenario for the purposes of assessing cumulative effects of wind projects and the contribution of each alternative to the cumulative impact.

Table 4-18 provides a summary of cumulative effects to bats from each of the analyzed alternatives and from the future installed capacity of wind projects in the OCRU. The Service predicts the No-Action

Alternative for the Project is unlikely to result in Indiana bat mortalities and, therefore, will not contribute to cumulative impacts to Indiana bats. Alternative 2 would take an estimated 1.57 Indiana bats per year and 47.1 bats over the duration of the permit, accounting for 0.32% of the cumulative take estimated for the OCRU during the same period. The Applicant’s proposal (Alternative 3) will take an estimated 2 Indiana bats per year and 60 Indiana bats over the full permit duration, accounting for 0.41% of the cumulative take estimated for the OCRU during this period.

The action alternatives are not substantially different in the extent to which they contribute to cumulative impacts to Indiana bats, particularly considering that the Applicant would offset estimated take associated with Alternatives 2 and 3 using mitigation of winter and summer habitat. Mitigation efforts also have the potential to increase the bat population beyond what is needed to offset take.

Northern Long-eared Bats

The Service’s final 4(d) rule northern long-eared bats provides an estimate of roughly 2.8 million northern long-eared bats in the Midwest Region (USFWS 2016*b*), which is Region 3. The Service cautions the use of this population estimates in the final 4(d) rule, which were estimated using a series of calculations based on occupancy and forest cover as opposed to actual counts. It is likely that the state populations are overestimates in areas affected by WNS. We used the occupancy data from the last 3 years, but in nearly all WNS areas there is a clear downward trend and most data are at least a year old. Therefore, the occupation rates and resulting population estimates are likely lower in many areas. Therefore, there is a great deal of uncertainty as to the accuracy of the population estimates, particularly for those states affected by WNS. However, this is the best population estimate that can be used to put the effects of wind mortality in context.

Table 4-4 includes 7 projects in Region 3 (Fowler Ridge, California Ridge, and 5 undisclosed sites) where post-construction monitoring results reported 7 northern long-eared bat fatalities. However, any project within the species’ range has the potential to take northern long-eared bats, particularly during the fall migratory season. Such was the case for the 1 documented occasion at Fowler Ridge over 3 years of monitoring. Fowler Ridge did not estimate a mortality rate for northern long-eared bats in their post-construction reports or HCP. To derive a region-wide mortality rate for northern long-eared bats, we chose to use the value described in Section 6.4.2.1.1 of the Project HCP, which is based on results from Fowler Ridge. We assumed that 0.08% of all bat fatalities will be northern long-eared bats. Hence, our cumulative mortality estimates for northern long-eared bats are derived directly from our unlisted bat mortality (described in the following section) and averages roughly 0.02 northern long-eared bats per turbine per year.

Based on the current installed capacity in Region 3 (11,168 turbines), approximately 192 northern long-eared bats are taken each year within Region 3, roughly 0.007% of the Region 3 population (2.8 million; USFWS 2016*b*). By year 2046, the annual take estimate will be roughly 370 northern long-eared bats, or 0.013% of the Region 3 population, based on the projected wind development indicated in Table 4-14 (22,412 turbines). Summing the annual mortality over the duration of the permit results in approximately 8,000 northern long-eared bats taken by wind projects cumulatively in Region 3 over 30 years (Table 4-18). This estimate assumes projects in Region 3 will not implement operational adjustments, which will not likely be the case. However, this represents a worst-case scenario for the purposes of assessing the contribution of each alternative to the cumulative totals.

Table 4-18. Cumulative effects to Indiana bats, northern long-eared bats, and unlisted bats from the Hoopeston Wind Project and projected installed wind power capacity in the Midwest.

Species	Impact	1: No-Action 49 Turbines	2: Mixed Operations 49 Turbines	3: Applicant's Proposal 49 Turbines	OCRU 2046 12,284 Turbines[1]
Indiana bat	Annual mortality	0	1.57	2	645[2, 3]
	Cumulative mortality	0	47.1	60	~15,000
	Project % contribution to cumulative mortality[1]	0	0.32	0.41	--
Species	**Impact**	**1: No-Action 49 Turbines**	**2: Mixed Operations 49 Turbines**	**3: Applicant's Proposal 49 Turbines**	**Region 3 2046 22,412 Turbines[1]**
Northern long-eared bat	Annual mortality	0	1.85	2	370[2, 3]
	Cumulative mortality	0	55.5	60	~8,000
	Project % contribution to cumulative mortality[1]	0	0.66	0.71	--
Unlisted bats	Annual mortality	352	943	1,074	~462,000[2, 3]
	Cumulative mortality	~10,600	~28,000	~32,000	~10.5 million
	Project % contribution to cumulative mortality[1]	0.10	0.27	0.31	--

[1] Estimation of OCRU and Region 3 mortality assumes all projects will operate with no adjustments (curtailment or feathering).
[2] Number of fatalities in year 2046.
[3] Indiana bat fatality rate = 0.05 bats per turbine per year
Northern long-eared bat fatalities were based on 0.08% of unlisted bat fatalities
Regional unlisted bat fatality rate = 20.61 bats per turbine per year

Table 4-18 provides a summary of cumulative effects to bats from each of the analyzed alternatives and from the future installed capacity of wind projects in Region 3. The Service predicts the No-Action Alternative for the Project is unlikely to result in northern long-eared bat fatalities and, therefore, will not contribute to cumulative impacts to northern long-eared bats. Alternative 2 will take an estimated 1.85 northern long-eared bats per year and 55.5 individuals over the course of the permit duration, accounting for 0.66% of the cumulative take estimated for Region 3 during the same period (Table 4-18). The Applicant's Proposal will take an estimated 2 northern long-eared bats per year and 60 individuals over the permit duration, accounting for 0.71% of the cumulative take estimated for Region 3 during this period.

The action alternatives are not substantially different in the extent to which they contribute to cumulative impacts to northern long-eared bats, particularly considering that the Applicant would offset estimated take associated with Alternatives 2 and 3 using mitigation of winter and summer habitat. Mitigation efforts also have the potential to increase the bat population beyond what is needed to offset take.

Unlisted Bats

Rates of mortality of unlisted bats vary substantially among projects and depend to a large extent on operational decisions and turbine characteristics, both of which are subject to change over time as the wind industry grows and becomes more sophisticated. For the purposes of assessing cumulative impacts to unlisted bats, we elected to use the simple average of rates derived from post-construction monitoring at 12 wind projects in the Midwest shown in Table 4-5. Applying the rate of 12.6 bats per MW to the current installed capacity in Region 3 of 18,265 MW results in 230,139 bat fatalities. To derive a per turbine rate, we divide this number by the current number of installed turbines, 11,168, to obtain an annual mortality rate of 20.61 bats per turbine. We assumed this rate of 20.61 bats per turbine will remain constant during the 30-year permit duration.

Based on a rate of 20.61 bats per turbine per year and the current installed capacity of 11,168 turbines, wind projects in Region 3 in 2015 are estimated to have caused roughly 230,000 unlisted bat fatalities. Applying the same fatality rate to the potential installed capacity of 22,412 turbines in year 30 of the permit indicates an annual mortality of approximately 462,000 unlisted bats in Region 3 and a cumulative total of roughly 10.5 million unlisted bats taken during this 30-year period. We have assumed that the rate of 20.61 bats per turbine per year is the appropriate rate. However, regional fatality rates for bats are likely to be less than predicted, as operational curtailment is becoming more common and may significantly reduce unlisted bat mortality region-wide. Nonetheless, these numbers provide a practical estimation of cumulative effects to bats in Region 3.

Cumulative mortality for unlisted bats across the three alternatives ranges from 10,600 to 32,000 bats over the 30-year permit duration, accounting for 0.10 to 0.31% of cumulative mortality for Region 3, with Alternative 3 accounting for the highest total cumulative mortality (Table 4-18). The action alternatives are not substantially different in the extent to which they contribute to cumulative impacts to unlisted bats in Region 3.

Region-wide, it is not possible to estimate what effect 10.5 million bat fatalities over 30 years would have on the population of unlisted bats as no baseline population estimates exist for these species. This particularly applies to the long-distance migratory species, the species group most likely to be affected by wind turbine mortality. Implementation of any action alternative will require the Applicant to offset estimated take of listed bats using mitigation measures, but these measures are unlikely to significantly benefit long-distance migratory bats.

4.5.1.1 White-nose Syndrome

WNS has emerged as the largest single source of mortality for cave-hibernating bats in recent years. As of August 2017, WNS has been confirmed in 29 states and 5 Canadian provinces, and suspected in 2 states (USFWS 2017*b*). Current estimates of total bat mortality reach 6.7 million cave-hibernating bats total since discovery of the disease in 2006 (USFWS 2012*c*). To date, WNS has not been documented in long-distance migratory bat species (hoary bat, silver-haired bat, eastern red bat), which account for the majority of wind turbine related mortality.

Turner et al. (2011) documented an 88% decline in overall numbers of hibernating bats comparing pre- and post-WNS counts at 42 sites in 5 northeastern states with declines varying by species. At these sites, northern long-eared bats decreased by 98%, little brown bats by 91%, tri-colored bats by 75%, Indiana bats by 72%, big brown bats by 41%, and eastern small-footed bats by 12% (Turner et al. 2011). It is unclear if the Midwest will experience the same outcomes observed in the northeast. The 2015 population estimates for the Indiana bat show 0.3% and 9.7% declines since 2013 for Region 3 and the OCRU, respectively (USFWS 2015*c*). The 2017 population estimates for the Indiana bat show 0.3% decline for Region 3 and 0.3% increase for the OCRU since 2015 (USFWS 2017*a*). The population status for northern long-eared bats is not well understood, and declines are difficult to track. Currently, there is no evidence to suggest that northern long-eared bats will not experience similar declines in the Midwest.

Based on counts of Indiana bats from winter surveys at known Priority 1 and 2 hibernacula, the Appalachian Mountain Recovery Unit declined by 84% between 2011 and 2015 (USFWS 2015*c*) more than likely due to WNS. Indiana bat mortality estimates in individual hibernacula have reached 100% (Turner et al. 2011). This does not necessarily represent the total decline due to WNS, although certain northeastern bat populations appear to be stabilizing or even increasing gradually several years following the initial outbreak of WNS. As of winter 2015, the disease has been confirmed in multiple hibernacula in the OCRU, but such precipitous declines have not been observed as it is still too soon. Mortality associated with the disease in the OCRU and Region 3 could be similar to that documented in the Northeast. An 84% decline in Indiana bat population in the OCRU from 2015 would amount to a loss of more than 200,000 Indiana bats during a period of 3 to 4 years. Such a decline in Indiana bat populations across the region will likely reduce the probability of Indiana bat mortality at wind projects.

As described in the HCP (see Section 8.1.2.1), if the Service determines that declines in the Indiana bat population in the OCRU and/or northern long-eared bat population in the Midwest constitute a changed circumstance, Hoopeston Wind will reassess the degree to which the authorized take impacts the population and determine whether turbine operational adjustments are warranted. In coordination with the Service, Hoopeston Wind will analyze whether the level of Indiana bat take at the Project is having a material negative effect (after accounting for benefits of mitigation) to the remaining Indiana bat populations in the OCRU or northern long-eared bat population in the Midwest. If the analysis demonstrates that a 35% take reduction is no longer sufficient to prevent material negative effects with the declining population, Hoopeston Wind will implement additional operational restrictions or minimization measures by the next bat spring emergence season (April). These additional measures will be determined through consultation with the Service, which will determine what level of take reduction prevents material negative effects. Similarly, should additional bat species be listed due to declines from WNS, Hoopeston Wind will evaluate the potential for take of newly listed species and will determine whether to add the species to the HCP, or in the case of the little brown bat, seek a permit under the Midwest Wind Energy Multi-species Habitat Conservation Plan (public review draft, USFWS 2016*c*).

4.5.1.2 Habitat Loss and Fragmentation

Cumulative impacts of land use conversion and habitat fragmentation on bats in the Midwest have largely taken place in the past, as agricultural land use has dominated the region for decades. Construction of Hoopeston Wind and most other Midwestern wind projects does not result in additional forest clearing and may even create forested habitat through efforts to mitigate impacts to bats. Therefore, Hoopeston Wind and expansion of wind energy in the region are not expected to contribute to any incremental cumulative effects of summer bat habitat loss.

Similarly, winter bat habitat (caves and mines) are relatively static features on the landscape and are not being threatened by specific threats associated with habitat loss. WNS may have drastic impacts on hibernating bat populations, but will not alter the physical characteristics of hibernacula. The applicant will not have any impact on hibernacula and therefore not contribute to any cumulative impacts to winter bat habitat.

4.5.1.3 Cumulative Effects Summary

The BBCS for all alternatives includes a monitoring plan and adaptive management framework designed to monitor bird mortality and respond to major bird mortality events should they occur. The Service does not anticipate the Project or wind energy projects in Region 3 will result in cumulative impacts to birds that will result in species decline. Nor do we consider bird mortality from wind energy to be noticeably additive to the mortality sustained by birds from other anthropogenic sources, which have a much more significant impact.

We acknowledge that bat mortality at wind projects contributes to overall bat mortality, and the Project mortality will contribute cumulatively to other wind project mortality. Compared to the effects of WNS, cave-dwelling bat mortality at wind energy facilities is minor. However, wind energy facilities kill more migratory tree-dwelling bats than any other known documented source.

All three alternatives will contribute cumulatively to effects associated with bat mortality. Based on preliminary results of post-construction monitoring at the Project, feathering turbines at 6.9 m/s resulted in 44 detected bat fatalities in fall 2015. We estimate the No-Action Alternative will result in roughly 350 unlisted bat fatalities annually (Table 4-12). Between the two action alternatives, Alternative 2 will contribute the lower cumulative bat mortality. Under any of the three alternatives, there will be some impact associated with either avoidance or displacement should bats react to the presence of turbines. The HCP, as part of either action alternative, and BBCS, for all alternatives, both include a monitoring plan and adaptive management framework designed to monitor bat mortality and respond to significant bat mortality should it be identified.

By 2046, the cumulative impact of wind power projects in Region 3 is predicted to result in mortality of roughly 10.5 million bats, most of these being long-distance migratory bats. The effect of cumulative mortality on long-distance migratory bat populations is highly uncertain because estimates of current population sizes are unknown. However, their mortality at wind power projects is much higher than that experienced by cave-dwelling bats and is considered an additive effect to other stressors adversely affecting population levels (such as disease, predation, and habitat loss and degradation which decreases reproduction and survival). Despite these expected impacts to bats, all three alternatives would contribute a small portion of the total cumulative impact (0.10% to 0.31%) as explained in our analysis above.

CHAPTER 5. CONSULTATION AND COORDINATION

5.1 AGENCY COORDINATION

In support of their application to build a wind energy project in Vermilion County, the Applicant consulted with the Service, IDNR, Illinois State Historic Preservation Agency, and other state and local agencies. The Service has engaged IDNR in discussions on possible sites for conducting projects suitable for mitigating the unavoidable impacts of taking Indiana bats and northern long-eared bats.

5.2 DISTRIBUTION OF THE DRAFT EA

In accordance with NEPA, the Draft EA was circulated for public review and comment. The public review period was initiated with the publication of the Notice of Availability in the Federal Register and the public comment period extended for 30 days from the date of publication.

The Draft EA was distributed to individuals and organizations who specifically requested a copy of the document. The Service provided copies to other interested organizations or individuals upon request. In addition, copies or web links were sent to the following list of elected officials, federal agencies, and state, county, and local offices. The same interested parties were notified of the availability of the Final EA.

- Federal agencies
  - U.S. Department of the Interior
  - U.S. Department of the Interior, U.S. Fish and Wildlife Service
  - U.S. Forest Service, Shawnee National Forest
  - U.S. Department of Transportation, Office of the Secretary
  - U.S. Army Corps of Engineers, Rock Island District
  - U.S. Environmental Protection Agency, Region 5
  - U.S. Department of Agriculture Rural Development – Champaign Area Office
  - Natural Resources Conservation Service
  - U.S. Department of Energy
  - U.S. Department of Housing and Urban Development
  - Federal Emergency Management Agency, Region 5
  - Federal Communications Commission
  - Federal Aviation Administration
  - Federal Railroad Administration
  - Federal Highway Administration, Midwest Resource Center
  - U.S. Department of Commerce
  - Advisory Council on Historic Preservation

- State agencies
  - Office of the Secretary of State Jesse White

- Attorney General's Office Lisa Madigan
- Illinois Environmental Protection Agency
- Illinois Department of Agriculture
- Illinois Historic Preservation Agency
- Illinois Department of Transportation
- Illinois Department of Natural Resources

- Federal and state-elected officials
    - Governor Bruce Rauner
    - Honorable Mark Kirk (U.S. Senator)
    - Honorable Dick Durbin (U.S. Senator)
    - Honorable John Shimkus (U.S. Representative)
    - Honorable Adam Kinzingr (U.S. Representative)
    - Honorable Thomas Bennett (State Representative)
    - Honorable Jason Barickman (State Senator)

- Local units of government
    - Vermilion County Commissioners

- Others
    - The Nature Conservancy – Illinois
    - Illinois Audubon Society
    - Illinois Natural History Survey

CHAPTER 6. LIST OF PREPARERS

Name	Project Role and Qualifications
U.S. Fish and Wildlife Service	
Chase Allred Illinois-Iowa Ecological Services Field Office	EA Project Manager, EA Preparation and Review
Amber Schorg Illinois-Iowa Ecological Services Field Office	EA Preparation and Review
Tom Magnuson Regional Office	EA Preparation and Review
Kraig McPeek Illinois-Iowa Ecological Services Field Office	Project Leader/Responsible Official
Sharon Pudwill Solicitor	EA Review
Stantec Consulting Services Inc.	
Elizabeth Annand	EA Project Manager; EA Preparation M.S. Wildlife Biology 21 years' experience with ESA Section 7 and Section 10 consultation, T&E surveys, and NEPA documentation
Trevor Peterson	EA Preparation B.A. Biology/Environmental Studies 13 years' experience, including wildlife and T&E surveys, and Indiana bat and northern long-eared bat studies
Sarah Boucher	EA Preparation M.A. Ecology 10 years' experience with environmental studies, including wildlife and T&E surveys including Indiana bat
Geno Carpentier	Senior GIS Analyst and Graphics Preparation B.S. Geography and Wildlife Management 21 years' experience in graphics and GIS studies

CHAPTER 7. LITERATURE CITED

Amelon, S., and D. Burhans. 2006. Conservation assessment: *Myotis septentrionalis* (northern long-eared bat) in the eastern United States. Pages 69-82 *in* F.R. Thompson, III, editor. Conservation assessments for five forest bat species in the eastern United States. General Technical Report NC-260, Technical Guide. U.S. Department of Agriculture, Forest Service, North Central Research Station, Columbia, Missouri, USA.

APLIC (Avian Power Line Action Committee). 2006. Suggested practices for avian protection on power lines: the state of the art in 2006. Edison Electric Institute, APLIC, and California Energy Commission, Washington, DC and Sacramento, California, USA.

ARCADIS. 2013. Fall 2012 and spring 2013 avian and bat post-construction mortality monitoring report, Pioneer Trail Wind Farm. ARCADIS U.S., Inc. Milwaukee, Wisconsin, USA. 14 August.

ARCADIS. 2014. Fall 2013 and spring 2014 avian and bat post-construction mortality monitoring report, Pioneer Trail Wind Farm. ARCADIS U.S., Inc. Milwaukee, Wisconsin, USA. July.

Arnett, E. B., and E. F. Baerwald. 2013. Impacts of wind energy development on bats: implications for conservation. Pages 435-456 *in* R. A. Adams and S. C. Pedersen, editors. Bat evolution, ecology, and conservation. Springer, New York, New York, USA.

Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, and R. D. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61-78.

Arnett, E. B., W. P. Erickson, J. Kerns and, J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA. June.

Arnett, E. B., M. M. P. Huso, M. R. Schirmacher, and J. P. Hayes. 2011. Altering turbine speed reduces bat mortality at wind-energy facilities. Frontiers in Ecology and the Environment 9(4):209-214 doi: 10.1890/100103.

Arnett, E. B., G. D. Johnson, W. P. Erickson, and C. D. Hein. 2013. A synthesis of operational mitigation studies to reduce bat fatalities at wind energy facilities in North America. Prepared for The National Renewable Energy Laboratory. Bat Conservation International. Austin, Texas, USA. March.

Arnett, E. B., M. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2009. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA. April.

Arnold, T. W., and R. M. Zinc. 2011. Collision fatality has no discernible effect on population trends in North American Birds. PLoS ONE 6(9): e24708. Doi:10.1371/journal.pone.0024708.

ASRD and ACA (Alberta Sustainable Resource Development and Alberta Conservation Association). 2009. Status of the northern Myotis (*Myotis septentrionalis*) in Alberta. Wildlife Status Report No. 3. Alberta Sustainable Resource Development, Edmonton, Alberta, Canada.

Baerwald, E. F. 2008. Variation in the activity and fatality of migratory bats at wind energy facilities in southern Alberta: causes and consequences. Thesis. University of Calgary. Calgary, Alberta, Canada.

Baerwald, E. F., J. Edworthy, M. Holder, and R. M. R. Barclay. 2009. A large-scale mitigation experiment to reduce bat fatalities at wind energy facilities. Journal of Wildlife Management 73: 1077–1081.

Barbour, R. W., and W. H. Davis. 1969. Bats of America. University of Kentucky Press, Lexington, Kentucky, USA.

Bat Conservation International, Inc. (BatCon). 2015. Species profiles: Illinois. <http://www.batcon.org/resources/media-education/species-profiles>. Accessed 1 October 2015.

BHE. 2010. Post-construction bird and bat mortality study Cedar Ridge Wind Farm, Fond Du Lac County, Wisconsin, interim report. BHE Environmental, Inc., Cincinnati, Ohio, USA. February.

Boyles, J. G., and L. P. McGuire. 2014. Autumn migration of Indiana bats (*Myotis sodalis*) and northern myotis (*Myotis septentrionalis*) in eastern Illinois – potential implications for the Hoopeston and Ford Ridge wind energy projects. Interim report. Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, Illinois, USA. December.

Brack, V., and J. O. Whitaker. 2001. Foods of the northern myotis, *Myotis septentrionalis*, from Missouri and Indiana, with notes on foraging. Acta Chiropterologica 3: 203-210.

Broders, H. G., G. J. Forbes, S. Woodley, and I. D. Thompson. 2006. Range extent and stand selection for roosting and foraging in forest-dwelling northern long-eared bats and little brown bats in the Greater Fundy Ecosystem, New Brunswick. Journal of Wildlife Management 70: 1174-1184.

Caceres, M. C., and R. M. Barclay. 2000. *Myotis septentrionalis*. Mammalian Species No. 634. American Society of Mammalogists, Lawrence, Kansas, USA. 12 May.

Caceres, M. C., and M. J. Pybus. 1997. Status of the northern Myotis (*Myotis septentrionalis*) in Alberta. Wildlife Status Report No. 3. Alberta Environmental Protection, Wildlife Management Division, Edmonton, Alberta, Canada.

Caire, W., R. K. LaVal, M. L. LaVal, and R. Clawson. 1979. Note on the ecology of *Myotis keenii* in eastern Missouri. American Midland Naturalist 102: 404-407.

Carter, T. C., and G. A. Feldhamer. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management 219: 259–268.

CEQ (Council on Environmental Quality). 1997. Considering cumulative effects under the National Environmental Policy Act. Council on Environmental Quality, Executive Office of the President, Washington, D.C. January.

CEQ. 2016. Memorandum for heads of federal departments and agencies; final guidance for federal departments and agencies on consideration of greenhouse gas emissions and the effects of climate change in National Environmental Policy Act reviews. Council on Environmental Quality, Washington, DC. 1 August.

Chamberlain, D. E., M. R. Rehfisch, A. D. Fox, M. Desholm, and S. J. Anthony. 2006. The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis 148: 198–202.

Clay, R. P., A. J. Lesterhuis, and O. Johnson. 2010. Conservation plan for the American golden-plover (*Pluvialis dominica*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Cope, J. B., and S. R. Humphrey. 1977. Spring and autumn swarming behavior in the Indiana bat, *Myotis sodalis*. Journal of Mammalogy 58: 93–95.

Crampton, L. H., and R. M. R. Barclay. 1998. Selection of roosting and foraging habitat by bats in different-aged aspen mixedwood stands. Conservation Biology 12: 1347-1358.

Cryan, P. M. 2008. Mating behavior as a possible cause of bat fatalities at wind turbines. Journal of Wildlife Management 72: 845-849.

Cryan, P. M., M. A. Bogan, and G. M. Yanega. 2001. Roosting habits of four bat species in the Black Hills of South Dakota. Acta Chiropterologica 3: 43-52.

Dalthorp, D., M. Huso, D. Dail, and J. Kenyon. 2014. Evidence of absence software user guide. U.S. Geological Survey Data Series 881. <https://pubs.er.usgs.gov/publication/ds881>. Accessed 15 February 2015.

Dalthorp, D., M. Huso, and D. Dail. 2017. Evidence of absence (v2.0) software. U.S. Geological Survey data series 1055. 6 July. <https://pubs.er.usgs.gov/publication/ds1055>. Accessed 23 August 2017.

Derby, C., A. Dahl, W. Erickson, K. Bay, and J. Hoban. 2007. Post-construction monitoring report for avian and bat mortality at the NPPD Ainsworth wind farm. Western EcoSystems Technology, Inc. Cheyenne, Wyoming, USA.

Dooling, R. 2002. Avian hearing and the avoidance of wind turbines. NREL/TP-500-30844. National Renewable Energy Laboratory, Golden, Colorado, USA. June.

Dunne, P, D. Keller, and R. Kochenberger. 1984. Hawk watch: a guide for beginners. 2002, reprint. Cape May Bird Observatory, Cape May, New Jersey, USA.

Ecosystem Management (Ecosystem Management, Inc.) 2011. Avian and bat studies for the Hoopeston Wind Farm, Vermilion County, Illinois. Ecosystem Management, Inc., Albuquerque, New Mexico, USA. March.

England, A. B., B. French, K. Gaukler, C. Geiselman, B. Keeley, J. Kennedy, M. Kaiser, S. Kiser, R. Kowalski, D. Taylor, and S. Walker. 2001. Bats in eastern woodlands. Bat Conservation International, Austin, Texas, USA.

Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, and R. E. Good. 2001. Avian Collisions with Wind Turbines. A summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee Resource Document, Washington, D.C.

Erickson, W., Kronner, and B. Gritski. 2003. Nine Canyon Wind Power Project avian and bat monitoring report, September 2002 - August 2003. WEST, Inc., Cheyenne, Wyoming and Northwest Wildlife Consultants, Inc., Pendleton, Oregon, USA. October.

Erickson, W. P., M. M. Wolfe, K. J. Bay, D. H. Johnson, and J. L. Gehring. 2014. A comprehensive analysis of small-passerine fatalities from collision with turbines at wind energy facilities. PLoS ONE 9(9): e107491. doi:10.1371/journal.pone.0107491.

Ernst, C. H., and J. E. Lovich. 2009. Turtles of the United States, second edition. The Johns Hopkins University Press, Baltimore, Maryland, USA.

Fagen Engineering (Fagen Engineering, LLC). 2014. 2013 avian and bat monitoring, annual report, Big Blue Wind Farm, Blue Earth, Minnesota. Fagen Engineering, LLC, Granite Falls, Minnesota, USA.

Fagen Engineering. 2015. 2014 avian and bat monitoring, annual report, Big Blue Wind Farm, Blue Earth, Minnesota. Fagen Engineering, LLC, Granite Falls, Minnesota, USA.

Feldhamer, G. A., T. C. Carter, and J. O. Whitaker Jr. 2009. Prey consumed by eight species of insectivorous bats from southern Illinois. American Midland Naturalist 162: 43-51.

Fernley, J., S. Lowther, and P. Whitfield. 2006. A review of goose collisions at operating wind farms and estimation of the goose avoidance rate. West Coast Energy Developments Ltd, Hyder Consulting (UK) Ltd, and Natural Research Ltd, Mold, Warrington, and Aberdeenshire, UK. June.

Fiedler, J. K. 2004. Assessment of bat mortality and activity at Buffalo Mountain Wind Farm, Eastern Tennessee. M.S. Thesis, University of Tennessee, Knoxville, USA.

Fitch, J. H., and K. A. Shump. 1979. *Myotis septentrionalis*. Mammalian species no. 121. American Society of Mammalogists, Lawrence, Kansas, USA. 8 June.

Fleming, T. H., and P. Eby. 2003. Ecology of bat migration. Pages 156-197 *in* T. H. Kunz and M. B. Fenton, editors. Bat ecology. The University of Chicago Press, Chicago, Illinois, USA.

Foster, R., and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). Journal of Mammalogy 80: 659-672.

Fowler Ridge (Fowler Ridge Wind Farm LLC). 2013. Fowler Ridge Wind Farm, Indiana bat habitat conservation plan. Fowler Ridge Wind Farm LLC, Benton County, Indiana, USA. November.

Good, R. E, W. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, and C. Fritchman. 2011. Bat monitoring studies at the Fowler Ridge Wind Farm, Benton County, Indiana. April 1-October 31, 2010. Western EcoSystems Technology, Inc. Cheyenne, Wyoming, USA. 28 January.

Good, R. E., A. Merrill, S. Simon, K. Murray, and K. Bay. 2012. Bat monitoring studies at the Fowler Ridge Wind Farm, Benton County, Indiana. April 1-October 31, 2011. Western EcoSystems Technology, Inc. Bloomington, Indiana, USA. 31 January.

Good, R. E., M. L. Ritzert, and K. Adachi. 2013a. Post-construction monitoring at the Rail Splitter Wind Farm, Tazwell and Logan counties, Illinois. Western EcoSystems Technology, Inc. Bloomington, Indiana, USA. 16 December.

Good, R. E., J. P. Ritzert, and K. Adachi. 2013b. Post-construction monitoring at the Top Crop Wind Farm, Grundy and LaSalle counties, Illinois. Western EcoSystems Technology, Inc. Bloomington, Indiana, USA. 13 December.

Griffin, D. R. 1940. Notes on the life histories of New England cave bats. Journal of Mammalogy 21: 181-187.

Grodsky, S. M., and D. Drake. 2011. Assessing bird and bat mortality at the Forward Energy Center. University of Wisconsin-Madison, Madison, Wisconsin, USA.

Gruver, J., M. Sonnenburg, K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study at the Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin July 21, 2008–October 31, 2008 and March 15, 2009–June 4, 2009. Western EcoSystems Technology, Cheyenne, Wyoming, USA. 17 January.

Hale, B. T., K. L. Murray, and R. E. Good. 2014. Final report: habitat assessment for Indiana and northern long-eared bats, Hoopeston Wind Energy Facility, Vermilion County, Illinois, January 23-24, 2014. WEST, Inc., Bloomington, Indiana, USA. 23 April.

Helldin, J. O., J. Jung, W. Neumann, M. Olsson, A. Skarin, and F. Widemo. 2012. The impact of wind power on terrestrial mammals: a synthesis. Swedish Environmental Protection Agency. Stockholm, Sweden.

Henderson, L. E., and H. G. Broders. 2008. Movements and resource selection of the northern long-eared myotis (*Myotis septentrionalis*) in a forest-agriculture landscape. Journal of Mammalogy 89: 952-963.

Henderson, L. E., L. J. Farrow, and H. G. Broders. 2008. Intra-specific effects of forest loss on the distribution of the forest-dependent northern long-eared bat (*Myotis septentrionalis*). Biological Conservation 141: 1819–1828.

Hinman, J. L. 2010. Wind farm proximity and property values: a pooled hedonic regression analysis of property values in central Illinois. Thesis, Illinois State University, Normal, Illinois, USA.

Hoen, B., R. Wiser, P. Cappers, M. Thayer, and G. Sethi. 2009. The impact of wind power projects on residential property values in the United States: a multi-site hedonic analysis. Lawrence Berkeley National Laboratory, Berkley, California, USA. December.

HMANA (Hawk Migration Association of North America). 2006. Hawk migration studies. Volume XXXI, No. 2. Plymouth, New Hampshire, USA. February.

HMANA. 2014. Greene Valley Forest Preserve: Illinois: USA. <https://www.hawkcount.org/month_summary.php?rsite=660&ryear=2014&rmonth=11>. Accessed 28 September 2015.

HMANA. 2015. Hawk watch site selection, North America: USA: Illinois. <http://www.hawkcount.org/sitesel.php?country=USA&stateprov=Illinois>. Accessed 14 December 2015.

Houck, D. R., M. J. Lawson, and R. W. Thresher. 2012. A computational and analytical study of bats flying near wind turbines: implications regarding barotrauma. National Renewable Energy Lab, National Wind Technology Center, Louisville, Colorado, USA. <https://nationalwind.org/wp-content/uploads/assets/research_meeting_ix_presentations/7_1_Houck.pdf>. Accessed 14 December 2015.

Houston, C. S., C. R. Jackson, and D. E. Bowen, Jr. 2011. Upland sandpiper (*Bartramia longicauda*). A. Poole, editor. The Birds of North America Online, Issue No. 580. Cornell Lab of Ornithology, Ithaca, New York, USA.

Howe, R. W., W. Evans, and A. T. Wolf. 2002. Effects of wind turbines on birds and bats in northeastern Wisconsin. Prepared for Wisconsin Public Service Corporation and submitted to Wisconsin Public Service Corporation and Madison Gas and Electric Company. University of Wisconsin, Green Bay, Wisconsin, USA. 21 November.

IDES (Illinois Department of Employment Security). 2015. News release: unemployment down; job growth remains slow and uneven. Illinois Department of Employment Security, Springfield, Illinois, USA. 24 September.

IDNR (Illinois Department of Natural Resources). 2014. Illinois threatened and endangered species by county database. Division of Natural Heritage, Springfield, Illinois, USA. December. <http://www.dnr.illinois.gov/ESPB/Documents/ET_by_County.pdf>. Accessed 17 December 2015.

IEPA (Illinois Environmental Protection Agency). 2013 Illinois annual air quality report 2013. Illinois Environmental Protection Agency, Bureau of Air. Springfield, Illinois, USA. November.

Illinois Audubon Society. (not dated). Amboy Marsh. <http://www.illinoisaudubon.org/LANDCONSERVATION/AmboyMarsh.html>. Accessed 14 December 2015.

Illinois Audubon Society. (not dated). Plum Island Eagle Sanctuary. <http://www.illinoisaudubon.org/LANDCONSERVATION/PlumIsland.html>. Accessed 14 December 2015.

INHS. 2015*a*. *Ambystoma platineum* (Cope, 1867) silvery salamander. <http://wwx.inhs.illinois.edu/collections/herps/data/ilspecies/am_platine/>. Accessed 14 December 2015.

INHS. 2015*b*. *Hemidactylium scutatum* (Temminck and Schlegel, 1838) four-toed Salamander. <http://wwx.inhs.illinois.edu/collections/herps/data/ilspecies/he_scutatu/>. Accessed 14 December 2015.

INHS. 2015*c*. *Terrapene ornate* (Agassiz, 1857) ornate box turtle. <http://wwx.inhs.illinois.edu/collections/herps/data/ilspecies/te_ornata>. Accessed 23 October 2015.

INHS. 2015*d*. Least bittern (*Ixobrychus exilis*). <http://wwx.inhs.illinois.edu/collections/birds/ilbirds/36/#habitat>. Accessed 28 September 2015.

INHS. 2015*e*. Spring bird count: about the database; upland sandpiper graph. <http://wwx.inhs.illinois.edu/collections/birds/sbc>. Accessed 14 December 2015.

INHS. 2015*f*. Spring bird count database query results (upland sandpiper). <http://wwn.inhs.illinois.edu/databases/sbc/bird.php?bird_name=110&county_name=92&start_year=1975&end_year=2005>. Accessed 14 December 2015.

INHS. 2015*g*. Northern harrier (*Circus cyaneus*). <http://wwx.inhs.illinois.edu/collections/birds/ilbirds/46/#occurence>. Accessed 28 September 2015.

Illinois Raptor Center. (not dated). A pictorial guide to Illinois raptors, short-eared owl (*Asio flammeus*). <http://www.illinoisraptorcenter.org/shorteared.html>. Accessed 28 September 2015.

Illinois State Geological Survey. 2011. Physiographic divisions of Illinois. Illinois State Geological Survey, Champaign, Illinois, USA.

IPCC (Intergovernmental Panel on Climate Change). 2013. Climate change 2013: the physical science basis. Contribution of Working Group I to the fifth assessment report of the Intergovernmental Panel on Climate Change [Stocker, T. F., D. Qin, G.- K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley, editors]. Cambridge University Press, Cambridge, UK and New York, New York, USA.

Jain, A. 2005. Bird and bat behavior and mortality at a northern Iowa wind farm. Thesis, Iowa State University, Ames, Iowa, USA.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual report for the Noble Ellenburg Windpark, LLC, post-construction bird and bat fatality study– 2008. Curry and Kerlinger, LLC., Cape May Point, New Jersey, USA. 13 April.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and A. Harte. 2011. Annual report for the Noble Wethersfield Windpark, LLC post-construction bird and bat fatality study – 2010. Curry and Kerlinger, LLC., Cape May, New Jersey, USA. 22 January.

James, R. D. 2008. Erie Shores Wind Farm, Port Burwell, Ontario, fieldwork report for 2006 and 2007 during the first two years of operation. Report to Environment Canada, Ontario Ministry of Natural Resources, Erie Shores Wind Farm LP – McQuarrie North American and AIM PowerGen Corporation.

Jacques Whitford. 2009. Ripley Wind Power Project post-construction monitoring program. Jacques Whitford Stantec Limited, Markham, Ontario, Canada. 9 November.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, and D. A. Shepherd. 2000. Avian monitoring studies at the Buffalo Ridge, Minnesota Wind Resource Area: results of a 4-year study, final report for Northern States Power Company. Western EcoSystems Technology, Cheyenne, Wyoming, USA.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2002. Collision fatality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30: 879-887.

Johnson, J., J. D. Kiser, K. S. Watrous, T. S. Peterson. 2011. Day-roosts of *Myotis leibii* in the Appalachian Ridge and Valley of West Virginia. Northeastern Naturalist 18: 95-106.

Johnson, G., M. Perlik, W. Erickson, M. Strickland, D. Shepard, and P. Sutherland, Jr. 2003. Bat interactions with wind turbines at the Buffalo Ridge, Minnesota Wind Resource Area: an assessment of bat activity, species composition, and collision mortality. Western EcoSystems Technology, Cheyenne, Wyoming, USA.

Johnson, G.D., M.K. Perlik, W.P. Erickson, and M.D. Sutherland. 2004. Bat activity, composition and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin 32: 1278-1288.

Johnson, G. D., M. Ritzert, S. Nomani, and K. Bay. 2010. Final report: bird and bat fatality studies Fowler Ridge I Wind-Energy Facility, Benton County, Indiana, April 6–October 30, 2009. Western EcoSystems Technology, Cheyenne, Wyoming, USA. 12 April.

Johnston, C., and J. Peverly. 2008. Watershed implementation plan for Lake Vermilion and the North Fork Vermilion River, Vermilion County, Illinois. Vermilion County Soil and Water Conservation District, Danville, Illinois, USA. June.

Jung, T. S., I. D. Thompson, R. D. Titman, and A. P. Applejohn. 1999. Habitat selection by forest bats in relation to mixed-wood stand types and structure in central Ontario. Journal of Wildlife Management 63: 1306-1319.

Kerlinger, P., R. Curry, A. Hasch, and J. Guarnaccia. 2007. Migratory bird and bat monitoring study at the Crescent Ridge Wind Power Project, Bureau County, Illinois: September 2005-August 2006. Curry & Kerlinger, LLC, McLean, Virginia, USA. May.

Kerlinger, P. and J. Dowdell. 2008. Effects of wind turbines on grassland/hayfield nesting songbirds at the Maple Ridge Wind Power Project Lewis County, New York. Curry and Kerlinger, LLC, Cape May Point, New Jersey, USA. January.

Kerlinger, P., J. L. Gehring, W. P. Erickson, R. Curry, A. Jain, and J. Guarnaccia. 2010. Night migrant fatalities and obstruction lighting at wind turbines in North America. Wilson Journal of Ornithology 122: 744–754.

Kerlinger, P., J. Guarnaccia, L. Slobodnik, and R. Curry. 2011. A comparison of bat mortality in farmland and forested habitats at the Noble Bliss and Wethersfield windparks. Wyoming County, New York. Curry & Kerlinger, LLC, Cape May Point, New Jersey, USA. November.

Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the MWEC Wind Energy Center, Tucker County, West Virginia: annual report for 2003. Curry and Kerlinger, LLC, Cape May Point, New Jersey, USA. 14 February.

Kerns, J., W. P. Erickson, and E. B. Arnett. 2005. Bat and bird fatalities in Pennsylvania and West Virginia. Pages 24-95 *in* E. B. Arnett, editor. Relationships between bats and wind turbines in

Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bat Conservation International, Austin, Texas, USA.

Kunz, T. H., E. B. Arnett, W. P. Erickson, A. R. Hoar, G. D. Johnson, R. P. Larkin, M. D., Strickland, R. W. Thresher, and M. D. Tuttle. 2007*a*. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment 5: 315-324.

Kunz, T. H., E. B. Arnett, B. M. Cooper, W. P. Erickson, R. P. Larkin, T. Mabee, M. L. Morrison, M. D. Strickland, and J. M. Szewczak. 2007*b*. Assessing impacts of wind-energy development on nocturnally active birds and bats: a guidance document. Journal of Wildlife Management 71: 2449-2486.

Kurta, A. 1995. Mammals of the Great Lakes region. The University of Michigan Press, Ann Arbor, Michigan, USA.

Lacki, M. J., and J. H. Schwierjohann. 2001. Day-roost characteristics of northern bats in mixed mesophytic forest. Journal of Wildlife Management 65: 482-488.

LaVal, R. K., R. L. Clawson, M. L. LaVal, and W. Caire. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis*. Journal of Mammalogy 58: 592-599.

Leddy, K. L., K. E. Higgins, and D. E. Naugle. 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. Wilson Bulletin 111: 100-104.

Leopardi, S., D. Blake and S. J. Puechmaille. 2015. White-nose syndrome fungus introduced from Europe to North America. Current Biology 25: 17-19.

Longcore, T., C. Rich, and S. A. Gauthreaux, Jr. 2008. Height, guy wires, and steady-burning lights increase hazard of communication towers to nocturnal migrants: a review and meta-analysis. Auk: 125: 485–492.

Martin, J., E. J. Heske, and J. E. Hofmann. 2003. Franklin's ground squirrel (*Spermophilus franklinii*) in Illinois: a declining prairie mammal? American Midland Naturalist 150: 130–138.

MDC (Missouri Department of Conservation). 2015. White-nose syndrome in Missouri. <http://mdc.mo.gov/discover-nature/outdoor-recreation/caving/white-nose-syndrome-missouri>. Accessed 17 December 2015.

Menzel, M. A., S. F. Owen, W. M. Ford, J. W. Edwards, P. B. Wood, B. R. Chapman, and K. V. Miller. 2002. Roost tree selection by northern long-eared bat (*Myotis septentrionalis*) maternity colonies in an industrial forest of the central Appalachian Mountains. Forest Ecology and Management 155: 107–114.

MNDNR (Minnesota Department of Natural Resources). 2015. Smooth softshell turtle. <http://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=ARAAG01020>. Accessed 14 December 2015.

Murray, S. W., and A. Kurta. 2004. Nocturnal activity of the endangered Indiana bat (*Myotis sodalis*). Journal of Zoology, London 262: 197–206.

National Audubon Society. 2013*a*. Important Bird Areas in Illinois. <http://netapp.audubon.org/iba/IBAList/US-IL>. Accessed 28 September 2015.

National Audubon Society. 2013*b*. Important Bird Areas, Kennekuk County Park site profile. <http://netapp.audubon.org/iba/Site/3849>. Accessed 28 September 2015.

National Audubon Society. 2013*c*. Important Bird Areas, Forest Glen County Preserve site profile. <http://netapp.audubon.org/iba/Site/1677>. Accessed 28 September 2015.

NRC (National Research Council of the National Academies). 2007. Environmental impacts of wind-energy projects. Committee on Environmental Impacts of Wind Energy Projects, Board on Environmental Studies and Toxicology, Division of Earth and Life Studies. National Academies Press, Washington, D.C.

Osborn, R. G., C. D. Dieter, K. F. Higgins, and R. E. Usgaard. 1998. Bird flight characteristics near wind turbines in Minnesota. American Midland Naturalist 139: 29-38.

Osborn, R. G., K. F. Higgins, R. E. Usgaard, C. D. Dieter, and R. D. Neiger. 2000. Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Minnesota. American Midland Naturalist 143: 41-52.

O'Shea, T. J., M. A. Bogan, and L. E. Ellison. 2003. Monitoring trends in bat populations of the United States and territories; status of the science and recommendations for the future. Wildlife Society Bulletin 31: 16-29.

Owen, S. F., M. A. Menzel, W. M. Ford, B. R. Chapman, K. V. Miller, J. W. Edwards, and P. B. Wood. 2003. Home-range size and habitat used by the northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 150: 352-359.

PIF (Partners in Flight) Science Committee 2013. Population estimates database, version 2013. <http://rmbo.org/pifpopestimates>. Accessed on 4 November 2015.

Pearce-Higgins, J. W., L. Stephen, R. H. W. Langston, and J. A. Bright. 2008. Assessing the cumulative impacts of wind farms on peatland birds: a case study of golden plover *Pluvialis apricaria* in Scotland. Mires and Peat 4: Article 01.

Perry, R. W., and R. E. Thill. 2007. Roost selection by male and female northern long-eared bats in a pine-dominated landscape. Forest Ecology and Management. 247: 220-226.

Poulton, V. 2010. Summary of post-construction monitoring at wind projects relevant to Minnesota, identification of data gaps, and recommendations for further research regarding wind-energy development in Minnesota. Prepared for State of Minnesota Department of Commerce. Western EcoSystems Technology Inc. Cheyenne, Wyoming, USA. 10 December.

Ratcliff, J. M., and J. W. Dawson. 2003. Behavioral flexibility: the little brown bat, Myotis lucifugus, and the northern long-eared bat, *M. septentrionalis*, both glean and hawk prey. Animal Behavior 66: 847-856.

Recreation.gov. 2014. 12 Bald eagles hot spots on the Mississippi flyway. <http://www.recreation.gov/marketing.do?goto=acm/Explore_Go_Lists/12_Bald_Eagles_Hot_Spots_on_the_Mississippi_Flyway.htm#Indiana> Accessed 23 December 2015.

Reeder D. M., C. L. Frank, G. G. Turner, C. U. Meteyer, A. Kurta, E. R. Britzke, M.E. Vodzak, S. R. Darling, C. W. Stihler, A. C. Hicks, R. Jacob, L. E. Grieneisen, S. A. Brownlee, L. K. Muller, and D. S. Blehert. 2012. Frequent arousal from hibernation linked to severity of infection and mortality in bats with white-nose syndrome. PLoS ONE 7(6): e38920. doi:10.1371/journal.pone.0038920.

Ritzert, J. P., M. Kauffman, and C. Goodman. 2015. Post-construction monitoring at the Hoopeston Wind Project, Vermilion County, Illinois (fall 2015 and spring 2016), final report. Western Ecosystems Technology, Inc., Lemoyne, Pennsylvania, USA. October.

Rollins, K. E., D. K. Meyerholz, G. D. Johnson, A. P. Capparella, and S. S. Loew. 2012. A forensic investigation into the etiology of bat mortality at a wind farm: barotrauma or traumatic injury? Veterinary Pathology 49: 362–371.

Shoener Environmental. 2013. Post-construction bird/bat mortality monitoring report (2012), North Allegheny Wind Farm, Blair and Cambria Counties, Pennsylvania. Shoener Environmental, Dickson, Pennsylvania, USA. 1 March.

Smallwood, K. S. 2013. Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin 37: 19-33.

Smallwood, K. S., and C. Thelander. 2004. Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area. Final report to the California Energy Commission, Public Interest Energy Research–Environmental Area, Contract No. 500-01-019. BioResource Consultants, Ojai, California, USA.

Sparks, D. W., C. M. Ritzi, J. E. Duchamp, and J. O. Whitaker, Jr. 2005. Foraging habitat of the Indiana bat (*Myotis sodalis*) at an urban-rural interface. Journal of Mammalogy 86: 713–718.

Stantec. 2007. Kingsbridge I Wind Power Plant post-construction bird and bat monitoring report: 2006. File No. 160960204. Stantec Consulting Ltd., Guelph, Ontario, Canada. 7 March.

Stantec. 2010*a*. Cohocton and Dutch Hill Wind Farms year 1 post-construction monitoring report, 2009. Stantec Consulting Services Inc., Topsham, Maine, USA. March.

Stantec. 2010*b*. Stetson I Mountain Wind Project year 1 post-construction monitoring report, 2009. Stantec Consulting Services Inc., Topsham, Maine, USA. February.

Stantec. 2010*c*. Wolfe Island Ecopower Centre post-construction follow-up plan bird and bat resources. Monitoring report No. 2, July – December 2009. Stantec Consulting Ltd., Guelph, Ontario, Canada. May.

Stantec. 2011*a*. Wolfe Island Wind Plant post-construction follow-up plan bird and bat resources. monitoring report No. 3, January – June 2010. Stantec Consulting Ltd., Guelph, Ontario, Canada. January.

Stantec. 2011*b*. Bird mortality event at Laurel Mountain substation. Letter to the U.S. Fish and Wildlife Service West Virginia Field Office. Stantec Consulting Services Inc., Topsham, Maine, USA. 25 October.

Stantec. 2011*c*. Cohocton and Dutch Hill Wind Farms year 2 post-construction monitoring report, 2009. Stantec Consulting Services Inc., Topsham, Maine, USA. January.

Stantec. 2013. Fall 2011 and spring/summer 2012 post-construction monitoring, mortality estimate, acoustic analysis and curtailment study for the Laurel Mountain Wind Energy Project in Randolph and Barbour counties, West Virginia. Stantec Consulting Services Inc., Topsham, Maine, USA. March.

Stantec. 2015*a*. Fall 2014 acoustic bat survey, Hoopeston Wind Energy Project, Vermilion County, Illinois. Stantec Consulting Services Inc., Independence, Iowa, USA. 14 January.

Stantec. 2015*b*. 2014 Bird and bat post-construction monitoring report – Laurel Mountain Wind Energy Project, Randolph and Barbour counties, West Virginia. Stantec Consulting Services Inc., Topsham, Maine, USA. January.

Stantec. 2017. 2016 Post-Construction Monitoring Report, Hoopeston Wind Project, Vermilion County, Illinois. Stantec Consulting Services Inc., Independence, Iowa, USA. 11 January.

Stodola, K. W., B. J. O'Neal, M. G. Alessi, J. L. Deppe, T. R. Dallas, T. A. Beveroth, T. J. Benson, and M. P. Ward. 2014. Stopover ecology of American golden-plovers (*Pluvialis dominica*) in Midwestern agricultural fields. Condor 116: 162-172.

Strickland, D. 2004. Overview of non-collision related impacts from wind projects. Pages 34-38 *in* S. S. Schwartz, editor. Proceedings of the wind energy and birds/bats workshop: understanding and resolving bird and bat impacts. RESOLVE, Inc., Washington, DC. September.

Thelander, C.G., K. S. Smallwood, and L. Rugge. 2003. Bird risk behaviors and fatalities at the Altamont Pass Wind Resource Area. Period of performance: March 1998−December 2000. National Renewable Energy Laboratory, Golden, Colorado, USA. December.

Tidhar, D., M. Sonnenberg, and D. Young. 2013. Post-construction carcass monitoring study for the Beech Ridge Wind Farm, Greenbrier County, West Virginia, final report, April 1 – October 28, 2012. Western EcoSystems Technology, Inc., Waterbury, Vermont, USA. 18 January.

USBLS (U.S. Bureau of Labor Statistics). 2015.Unemployment rates for metropolitan areas, monthly rankings not seasonally adjusted, Sept. 2015. <http://www.bls.gov/web/metro/laummtrk.htm>. Accessed 12 November 2015.

US Census Bureau. 2015. State and county quick facts, Vermilion County, Illinois. <http://quickfacts.census.gov/qfd/states/17/17183.html>. Accessed 12 November 2015.

USDA (U.S. Department of Agriculture) Forest Service. 2003*a*. Conservation assessment for upland sandpiper (*Bartramia longicauda*). USDA Forest Service, Eastern Region, Threatened and Endangered Species Program, Milwaukee, Wisconsin, USA.

USDA Forest Service. 2003*b*. Conservation assessment for northern harrier (*Circus cyaneus*). USDA Forest Service, Eastern Region, Threatened and Endangered Species Program, Milwaukee, Wisconsin, USA.

USEPA (U.S. Environmental Protection Agency). 2016. Greenhouse gas equivalencies calculator. <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>. Accessed 14 October 2016.

Usgaard, R. E., D. E. Naugle, R. G. Osborn, and K. F. Higgins. Effects of wind turbines on nesting raptors at Buffalo Ridge in southwestern Minnesota. Proceedings of the South Dakota Academy of Science 76: 113-117.

USEIA (U.S. Energy Information Administration). 2015. Annual energy outlook 2015 with projections to 2040. Office of Integrated and International Energy Analysis, Washington, DC. April.

USEIA. 2016. Illinois state profile and energy estimates. <http://www.eia.gov/state/?sid=IL#tabs-4>. Accessed 14 December 2016.

USFWS (U.S. Fish and Wildlife Service). 2007. Indiana bat (*Myotis sodalis*) draft recovery plan: first revision. Region 3, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota, USA.

USFWS. 2008. Birds of conservation concern. Division of Migratory Bird Management, Arlington, Virginia, USA. <http://www.fws.gov/migratorybirds/pdf/grants/BirdsofConservationConcern2008.pdf>. Accessed 28 September 2015.

USFWS. 2011. Pennsylvania Field Office news. Indiana bat fatality at Pennsylvania wind facility. <http://www.fws.gov/northeast/pafo/index.html>. Accessed 15 December 2015.

USFWS. 2012*a*. Indiana bat fatality at West Virginia wind facility. U.S. Fish and Wildlife Service, West Virginia Field Office, Northeast Region. 23 August. <http://www.fws.gov/westvirginiafieldoffice/ibatfatality.html>. Accessed 2 October 2015.

USFWS. 2012*b*. Endangered Indiana bat found dead at Ohio wind facility; steps underway to reduce future mortalities. U.S. Fish and Wildlife Service, Newsroom, Midwest Region. 29 November. <http://www.fws.gov/midwest/News/release.cfm?rid=604>. Accessed 2 October 2015.

USFWS. 2012*c*. White-nose syndrome: a devastating disease of North American bats. U.S. Fish and Wildlife Service. August. <http://whitenosesyndrome.org/sites/default/files/resource/white-nose_fact_sheet_9-2012.pdf>. Accessed 2 October 2015.

USFWS. 2012*d*. Land-based wind energy guidelines. U.S. Fish and Wildlife Service, Arlington, Virginia, USA. 23 March.

USFWS. 2012*e*. Draft impact of take calculation for take of migratory Indiana bats at wind energy facilities, U.S. Fish and Wildlife Service, Midwest Region – Region 3, Bloomington Ecological Services Field Office, Bloomington, Indiana, USA. 17 February.

USFWS. 2013*a*. 2013 Rangewide population estimate for the Indiana bat (*Myotis sodalis*) by USFWS Region and Recovery Unit. U.S. Fish and Wildlife Service, Bloomington, Indiana, USA. 26 August.

USFWS. 2013*b*. Region 3 Indiana bat resource equivalency analysis model for wind energy projects. Bloomington Field Office, Bloomington, Indiana, USA. 31 January.

USFWS. 2013*c*. Eagle conservation plan guidance module 1 – land-based wind energy Version 2. U.S. Fish and Wildlife Service, Division of Migratory Bird Management. April.

USFWS. 2014. Northern long-eared bat interim conference and planning guidance. USFWS Regions 2, 3, 4, 5, & 6. 6 January.

USFWS. 2015*a*. National Spatial Data Infrastructure, wetlands layer. U.S. Fish and Wildlife Service, Division of Habitat and Resource Conservation, Branch of Resource and Mapping Support, Madison, Wisconsin, USA. May. <http://www.fws.gov/wetlands/Data/Mapper.html>. Accessed 6 November 2015.

USFWS. 2015*b*. Bald eagle nesting in the upper Midwest, county distribution. US Fish and Wildlife Service, Midwest Region, Bloomington, Minnesota, USA. 20 April. <http://www.fws.gov/midwest/eagle/conservation/baeacounties.html>. Accessed 8 November 2015.

USFWS. 2015*c*. 2015 Rangewide population estimate for the Indiana bat (*Myotis sodalis*) by USFWS region and recovery unit. U.S. Fish and Wildlife Service, Bloomington, Indiana, USA. 25 August.

USFWS. 2015*d*. Threatened species status for the northern long-eared bat with 4(d) rule; final rule and interim rule. Federal Register 80: 17974-18033. 2 April.

USFWS. 2016*a*. 4(d) rule for the northern long-eared bat, final rule. Federal Register 81: 1900-1922.

USFWS. 2016*b*. Programmatic biological opinion on final 4(d) rule for the northern long-eared bat and activities excepted from take prohibitions. Regions 2, 3, 4, 5, and 6. U.S. Fish and Wildlife Service, Bloomington, Minnesota, USA. 5 January.

USFWS. 2016*c*. Midwest wind energy multi-species habitat conservation plan, public review draft. U.S. Fish and Wildlife Service, Bloomington, Minnesota, USA. April.

USFWS. 2017a. 2017 Indiana bat (*Myotis sodalis*) population status update. Indiana Ecological Services Field Office, Bloomington, Indiana, USA. 5 July.

USFWS. 2017*b*. White-nose syndrome occurrence map – by year. 7 August. <https://www.whitenosesyndrome.org/resource/updated-white-nose-syndrome-map-august-7-2017>. Accessed 23 August 2017.

USFWS and NMFS (National Marine Fisheries Service). 1996. 1996. Habitat conservation planning and incidental take permit processing handbook. 4 November.

USFWS and NMFS. 2016. Habitat conservation planning handbook. 21 December. < https://www.fws.gov/endangered/esa-library/pdf/HCP_Handbook.pdf >. Accessed 6 January 2017.

Vermilion County Conservation District. (not dated). Illinois nature preserves. <http://www.vccd.org/preserves.html>. Accessed 28 September 2015.

VRWCP (Vermilion River Wildlife Conservation Partnership). 2011. Vermilion River (Middle Fork, North Fork, & Salt Fork) & Little Vermilion River conservation opportunity area wildlife action plan. March.

Vyn, R. J., and R. M. McCullough. 2014. The effects of wind turbines on property values in Ontario: does public perception match empirical evidence. Canadian Journal of Agriculture 62: 365-392.

Warnecke L., J. M. Turner, T. K. Bollinger, J. M. Lorch, V. Misra, P. M. Cryan, G. Wibbelt, D. S. Blehart, and C. K. R. Willis. 2012. Inoculation of bats with European *Geomyces destructans* supports the novel pathogen hypothesis for the origin of white-nose syndrome. Proceedings of the National Academy of Sciences 109: 6999–7003.

Whitaker, J. O., Jr., and L. J. Rissler. 1992. Winter activity of bats at a mine entrance in Vermillion County, Indiana. American Midland Naturalist 127: 52-59.

Whitfield, D. P. 2009. Collision avoidance of golden eagles at wind farms under the ‘Band’ collision risk model, report to Scottish Natural Heritage. Natural Research Ltd, Banchory, UK.

Young, D. P., W. P. Erickson, K. Bay, S. Nomani, and W. Tidhar. 2009. Mount Storm Wind Energy facility, phase 1 post-construction avian and bat monitoring, July – October 2008. Western EcoSystems Technology, Inc. Cheyenne, Wyoming, USA.

Young, D. P., K. Bay, S. Nomani, and W. L. Tidhar. 2010. NedPower Mount Storm Wind Energy Facility, post-construction avian and bat monitoring, July - October 2009. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA.

Young, D. P., K. Bay, S. Nomani, and W. L. Tidhar. 2011. NedPower Mount Storm Wind Energy Facility, post-construction avian and bat monitoring, July - October 2010. Western EcoSystems Technology, Inc. Cheyenne, Wyoming, USA.

Young, D. P., S. Nomani, Z. Courage, and K. Bay. 2012. Nedpower Mount Storm Wind Energy Facility post-Construction avian and bat monitoring: July - October 2011. Western EcoSystems Technology, Inc. Cheyenne, Wyoming, USA.

Young, D., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-construction monitoring study, Criterion Wind Project, Garrett County, Maryland. April–November 2012. Western EcoSystems Technology, Inc. Cheyenne, Wyoming and Waterbury, Vermont, USA.